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POLLUTION OF THE DETROIT RIVER, MICHIGAN WATERS OF LAKE ERIE, AND THEIR TRIBUTARIES. FINDINGS

Richard D. Vaughan, et al

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Washington, D.C.

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SECTION I

INTRODUCTION AND BACKGROUND

PERSONNEL

Professional Staff

Richard D. Vaughan
Project Director

George L. Harlow
Deputy Project Director

Phillip L. Taylor
Chief, Engineering Evaluation Section

Daniel F. Krawczyk
Chief, Laboratory Section

Laurence B. O'Leary
Chief, Field Operations

Robert J. Burm
Chief, Surveillance Activities

Phillip G. Harris
Sanitary Engineer

Frederic C. Blanc
Sanitary Engineer

Louis B. Carrick
Biologist

Charles T. Elly
Chemist

Judith A. McLane
Chemist

Leota A. Dye
Bacteriologist

Albert C. Printz
Chief, Inventory Section

Ralph G. Christensen
Bacteriologist

Supporting Staff

Norma Bey
Secretary

John J. Komraus
Administrative Aide

Michael C. Dziak
Sampler and General Mechanic

Patricia L. Laurain
Secretary

Roland J. Hartranft
Sampler and Draftsman

Ed K. McCue
Boat Operator and Laboratory Assistant

Wilbur J. Hartranft
Boat Operator and General Mechanic

Mary Ann McGlathery
Secretary

Jeanne K. Helmling
Secretary

Helen M. McNaughton
Secretary

Charles E. Henricks
Boat Operator and General Mechanic

Naomi Nash
Secretary

Harold J. Henris
Boat Operator and General Mechanic

Robert M. Vadasy
Sampler and Laboratory Assistant

Kurt S. Yacuone
Sampler and Laboratory Assistant

INTRODUCTION

Under Section 8 of the Federal Water Pollution Control Act (33 U.S.C. 466 et seq.), the Governor of any State may request that the Secretary of Health, Education, and Welfare call a conference on pollution of interstate or navigable waters if that pollution is endangering health or welfare. On December 6, 1961, the Honorable John B. Swainson, then Governor of the State of Michigan, made such a request.

Governor Swainson, in his request, stressed the exemplary record of pollution abatement of the Michigan Water Resources Commission but stated that critical pollution problems in Michigan's southeastern complex made demands far beyond the scope of normal pollution control activities. The letter specifically requested the Secretary of Health, Education, and Welfare to assist the State of Michigan to identify and recommend methods for correcting the sources of pollution going into the Detroit River and subsequently into Lake Erie.

On December 19, 1961, Secretary of Health, Education, and Welfare Ribicoff replied to Governor Swainson, agreeing to his request and stressing the desirability of a cooperative State-Federal approach in meeting these water pollution control problems in the State of Michigan.

After a preliminary investigation of the problem by Federal and State water pollution control agencies, a conference was held on March 27 and 28, 1962, at the Veterans Memorial Building in Detroit, Michigan. Presentations concerning the present status of pollution in the southeast Michigan area were given by representatives of local, State, and Federal governmental agencies, civic groups, and industries to a group of State and Federal conferees. Of a total of six conferees, four represented the Michigan Water Resources Commission and two, including the chairman, the U.S. Department of Health, Education, and Welfare. The proceedings of this conference contain much valuable information covering the status of pollution in the southeast Michigan area.

The conferees unanimously agreed to the following conclusions and recommendations:

1. Lake St. Clair, the Detroit River, Lake Erie, and their tributaries within the State of Michigan are navigable waters within the meaning of section 8 of the Federal Water Pollution Control Act.

2. Pollution of navigable waters subject to abatement under the Federal Water Pollution Control Act is occurring in the Michigan waters of Lake St. Clair, the Detroit River, Lake Erie, and their tributaries. The discharges causing and contributing to the pollution come from various industrial and municipal sources.

3. This pollution causes deleterious conditions so as to interfere with legitimate water uses, including municipal and industrial water supplies, fisheries resources, commercial and sport fishing, swimming, water skiing, pleasure boating, and other forms of recreation.

4. It is too early, on the basis of the record of the conference, to make an adequate judgment of the adequacy of the measures taken toward abatement of the pollution. The conference discussions demonstrate that there are many gaps in our knowledge of sources of pollution and their effects.

5. Cognizance is taken of the program of the Michigan Water Resources Commission for development of adequate pollution control measures on a progressive basis and the excellent progress being made by many municipalities and industries under this program. Delays encountered in abating the pollution may well be caused by the existence of a municipal and industrial complex concentrated in an area with a limited water resource. The conferees are also aware of the vast problems that Detroit faces as a result of the storm water outflow from a system of combined sewers. The

problem thus becomes one of approaching the entire area on a coordinated basis and putting in adequate facilities based on an overall plan.

6. Cognizance is also taken of the six-county study as a useful approach to the solution of the pollution problem in the Detroit area.

7. The Department of Health, Education, and Welfare, in order to close the gaps in the knowledge as to sources of pollution, nature of pollution and the effects thereof, appropriate methods of abatement, and appropriate methods to avoid delays in abatement, will initiate an investigation and study to gather data and information on the waters involved. This investigation and study will be carried on in close cooperation with the State agencies concerned, with the details of the investigation to be determined by the technical staffs of the Department of Health, Education, and Welfare, the Michigan Department of Health, and the Michigan Water Resources Commission. The Department of Health, Education, and Welfare will establish a resident survey group to provide technical assistance for this investigation.

8. The Department of Health, Education, and Welfare will prepare reports on the progress of this investigation at six-month intervals which will be made available to the Michigan Water Resources Commission. The Michigan Water Resources Commission will make information contained in these reports available to all interested parties.

9. The conference will be reconvened at the call of the chairman with the concurrence of the Michigan Water Resources Commission to consider the results obtained from the investigation and study, and to agree on action to be taken to abate pollution.

Organization of the Project

In order to carry out the mandate of the conference, the Detroit River-Lake Erie Project was established by the Public Health Service of the U.S. Department of Health, Education, and Welfare, with the following objectives:

1. To determine the extent of pollution in the United States portion of the Detroit River and the Michigan section of Lake Erie.

2. To investigate principal sources of pollution in this area and the contribution from these sources.

3. To determine the effect of pollution on various water uses.

4. To prepare a plan, or plans, for abatement of pollution in the area.

The Detroit River-Lake Erie Project was conducted as a special project of the Enforcement Branch of the Division of Water Supply and Pollution Control, Public Health Service, U.S. Department of Health, Education, and Welfare. Immediate supervision was provided by a Project Director who in turn was responsible to the Regional Program Director, Water Supply and Pollution Control, PHS, DHEW, Region V, Chicago, Illinois.

As required in conclusion number 8, six-month Progress Reports were prepared by the Project and furnished to the Michigan Water Resources Commission for distribution to interested parties. These reports described the organization and function of the Project and were accompanied by pertinent facts regarding plans and accomplishments toward meeting Project objectives. Each report contained a current personnel roster and organization table. A Technical Committee was established to inform interested parties of Project plans and activities of other local and State agencies to prevent needless duplication of effort. Table 1-I lists the members and technical advisors to this committee.

TABLE 1-I

DETROIT RIVER-LAKE ERIE PROJECT

TECHNICAL COMMITTEE

MEMBERS:

H. W. Poston (Chairman)
Regional Program Director
Department of Health, Education, and Welfare
Public Health Service, Region V
Water Supply and Pollution Control
433 West Van Buren Street
Chicago 7, Illinois

A. R. Balden
Chemical Engineering Department
Chrysler Corporation
Box 1118
Detroit 31, Michigan

Gordon Gregory
Metropolitan Research Bureau
United Auto Workers
8000 East Jefferson Avenue
Detroit, Michigan

Peter G. Kuh
Enforcement Branch
Department of Health, Education, and Welfare
Public Health Service
Division of Water Supply and Pollution Control
330 Independence Avenue, S. W.
Washington 25, D. C.

J. O. McDonald
Program Representative, Construction Grants
Department of Health, Education and Welfare
Public Health Service, Region V
Water Supply and Pollution Control
433 West Van Buren Street
Chicago 7, Illinois

Gerald Remus, General Manager
City of Detroit Board of Water Commissioners
735 Randolph Street
Detroit 26, Michigan

TECHNICAL ADVISORS:

Keith S. Krause
Chief, Technical Services Branch
Department of Health, Education, and Welfare
Public Health Service
Division of Water Supply and Pollution Control
330 Independence Avenue, S. W.
Washington 25, D. C.

Dr. Justin Leonard
Michigan Department of Conservation
Stevens T. Mason Building
Lansing, Michigan

Loring F. Oeming
Executive Secretary
Michigan Water Resources Commission
Reniger Building, 200 Mill Street
Lansing, Michigan

Donald M. Pierce
Michigan Department of Health
Lansing, Michigan

PROJECT DIRECTOR

Richard D. Vaughan
Project Director
Detroit River-Lake Erie Project
Public Health Service
U.S. Naval Air Station
Grosse Ile, Michigan
Phone No.: 676-6500

After the decision of the conferees to establish a field study, headquarters were located at the U.S. Naval Air Station, Grosse Ile, Michigan. A staff of 25 persons was recruited and necessary equipment and supplies procured. Extensive modification of facilities was required prior to full-scale operation. The technical staffs of the Michigan Water Resources Commission, the Michigan Department of Health, and the Public Health Service met soon after the conference to discuss the scope and function of the study.

Agreement concerning each agency's role in the undertaking was reached and procedures established to assure satisfactory communication among those concerned. The resultant operational plan recognized the responsibilities of both Federal and State organizations and was designed to obtain the needed facts with a minimum expenditure of funds and maximum participation from each of the three agencies.

Following the acquisition of headquarters, a detailed program management plan was compiled using the Program Evaluation and Review Technique. A target date of October 1, 1964, was established for completion of the final report. A description of the office, laboratory, and field activities as well as the magnitude of accomplishments during each six-month period are given in each of the four Progress Reports.

Coordination with the Detroit Field Unit of the International Joint Commission was effected to increase the efficiency of both organizations and prevent needless duplication of effort. The IJC Detroit Field Unit is staffed by personnel of the Michigan Water Resources Commission and the Public Health Service, making such cooperation and coordination appropriate. Results of Detroit River sampling performed by the Detroit Project were made available to the IJC and vice versa.

To facilitate reading and comprehension of this report, only summaries of technical data are given, in the forms of maps, charts, graphs, and tables. The detailed data and other information upon which conclusions found in this report are based are available in the files of the Department of Health, Education, and Welfare.

Operation of the Project

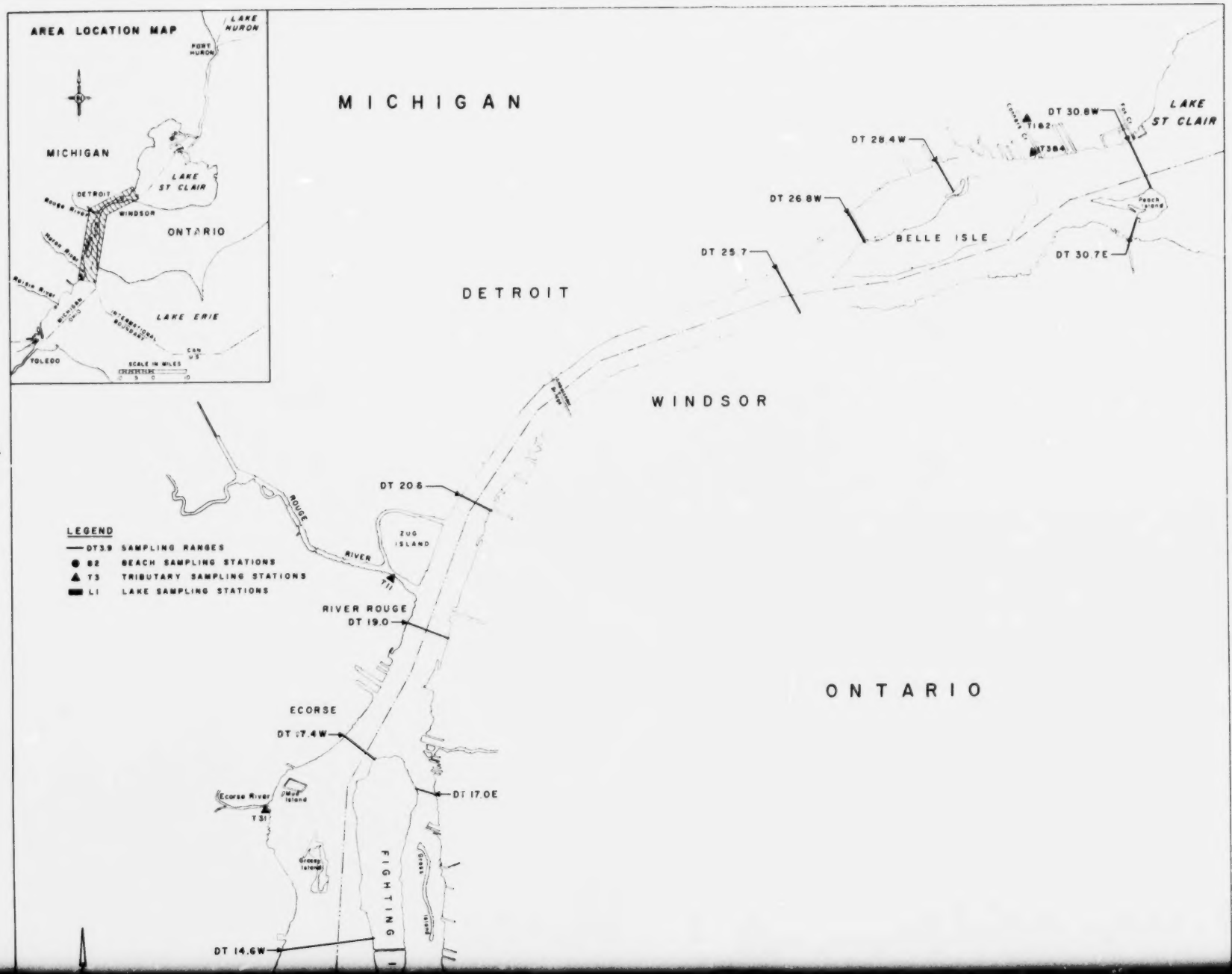
Sampling Stations

The Project staff first determined the need for field data by reviewing previously collected information. For the most part sampling ranges across the Detroit River previously established by the International Joint Commission were used. New stations were selected in Lake Erie and on several tributaries, and a network of bathing beach sampling stations was established. Figures 2-I and 3-I show the location of these sampling points. In addition, over 100 industrial waste outfalls were regularly sampled throughout the study.

In general, samples were collected weekly, between 9 A.M. and 1 P.M. Intensive studies were also conducted to determine variation in water quality throughout the day, with samples taken at 3 hour intervals. In all, over 25,000 samples were collected, upon which over 135,000 determinations were made. 44 types of bacteriological, chemical, physical, and biochemical tests were performed.

With the exception of certain biological and bottom deposit studies, all samples were collected at or near the surface of the River or Lake. A special survey was made to assure that this procedure produced representative results. Samples collected at varying depths were compared for several measures of pollution and the correlation coefficients computed. A coefficient greater than 0.7 was considered sufficient to warrant substitution of surface for depth sampling. The differences among results at varying depths were not great enough to justify the additional time, expense, and decrease in scope involved in conducting an overall depth sampling program. Over 3,500 determinations were made on 758 samples before this conclusion was drawn, and for one index--dissolved oxygen--depth sampling was continued (to cover the event that other seasons might show greater differences among depths).

Spot samples from industrial waste sources were collected throughout the survey, and special surveys, conducted cooperatively with State agencies, were made of both


AREA LOCATION MAP
LAKE HURON
PORT HURON
MICHIGAN
LAKE ST CLAIR
DETROIT
WINDSOR
ONTARIO
LAKE ERIE
TOLEDO
SCALE IN MILES
MICHIGAN
DETROIT
WINDSOR
ONTARIO
LAKE ST CLAIR
BELLE ISLE
DT 30.8W
DT 28.4W
DT 26.8W
DT 25.7
DT 30.7E
DT 20.6
ROUGE
RIVER
ZUG ISLAND
T11
RIVER ROUGE
DT 19.0
ECORSE
DT 17.4W
DT 17.0E
Ecorse River
T31
FIGHTING
DT 14.6W
LEGEND
DT3.9 SAMPLING RANGES
B2 BEACH SAMPLING STATIONS
T3 TRIBUTARY SAMPLING STATIONS
L1 LAKE SAMPLING STATIONS

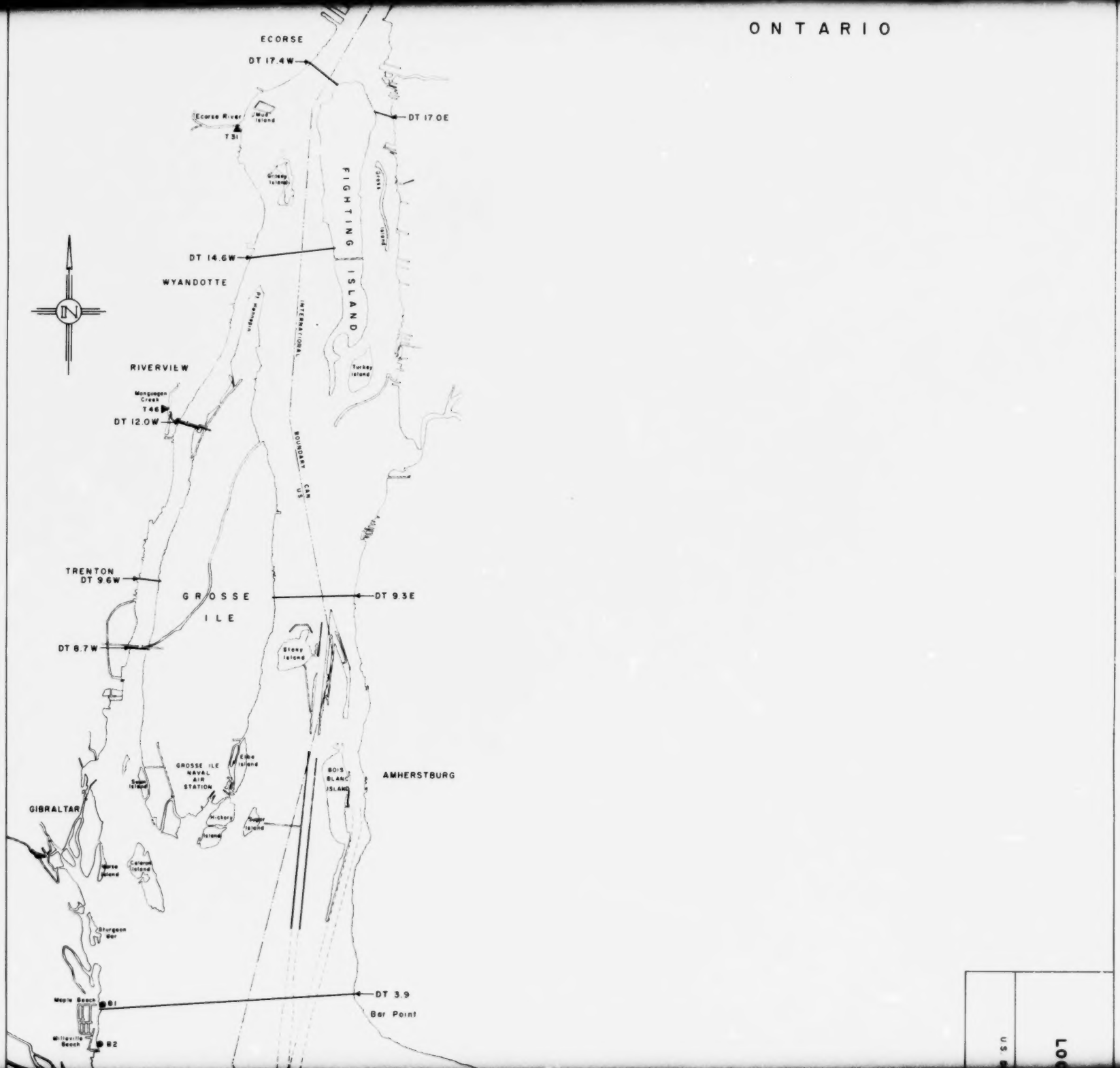

ONTARIO
ECORSE
DT 17.4W
DT 17.0E
Ecorse River
Mud Island
T31
Grassy Island
FIGHTING ISLAND
Grass Island
DT 14.6W
WYANDOTTE
Pt Wahnsapin
INTERNATIONAL BOUNDARY CAN US
Turkey Island
RIVERVIEW
Monguegon Creek
T46
DT 12.0W
TRENTON
DT 9.6W
GROSSE ILE
DT 9.3E
DT 8.7W
Stony Island
GROSSE ILE NAVAL AIR STATION
Elbe Island
Swan Island
BOIS BLANC ISLAND
AMHERSTBURG
GIBRALTAR
Hickory Island
Sugar Island
Morse Island
Celeron Island
Sturgeon Bar
Maple Beach
B1
DT 3.9
Bar Point
Milleville Beach
B2

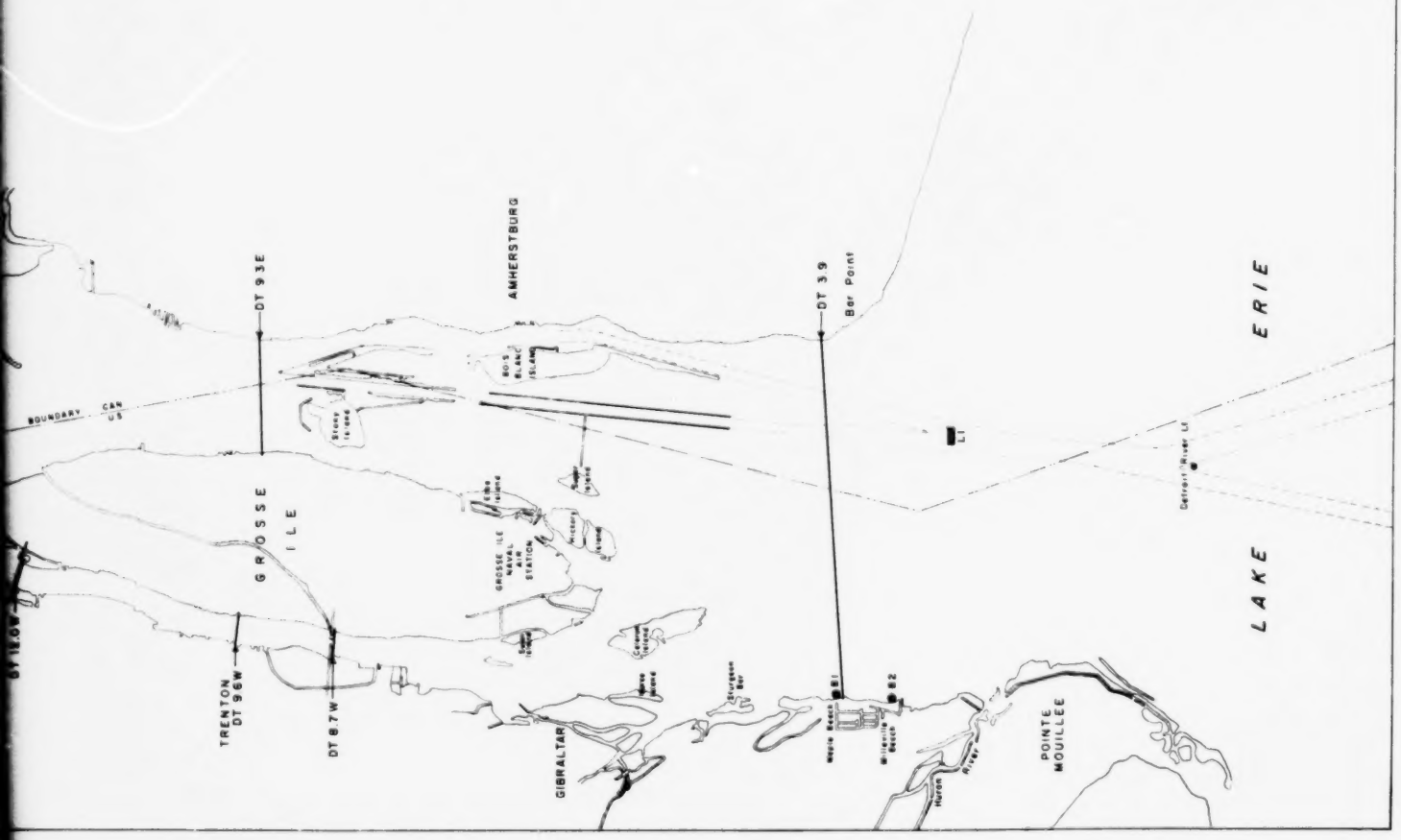
FIGURE 2-I

DETROIT RIVER-LAKE ERIE PROJECT

LOCATION OF SAMPLING STATIONS

DETROIT RIVER

U.S. DEPARTMENT OF HEALTH, EDUCATION, AND WELFARE
PUBLIC HEALTH SERVICE
REGION V GROSSE ILE, MICHIGAN



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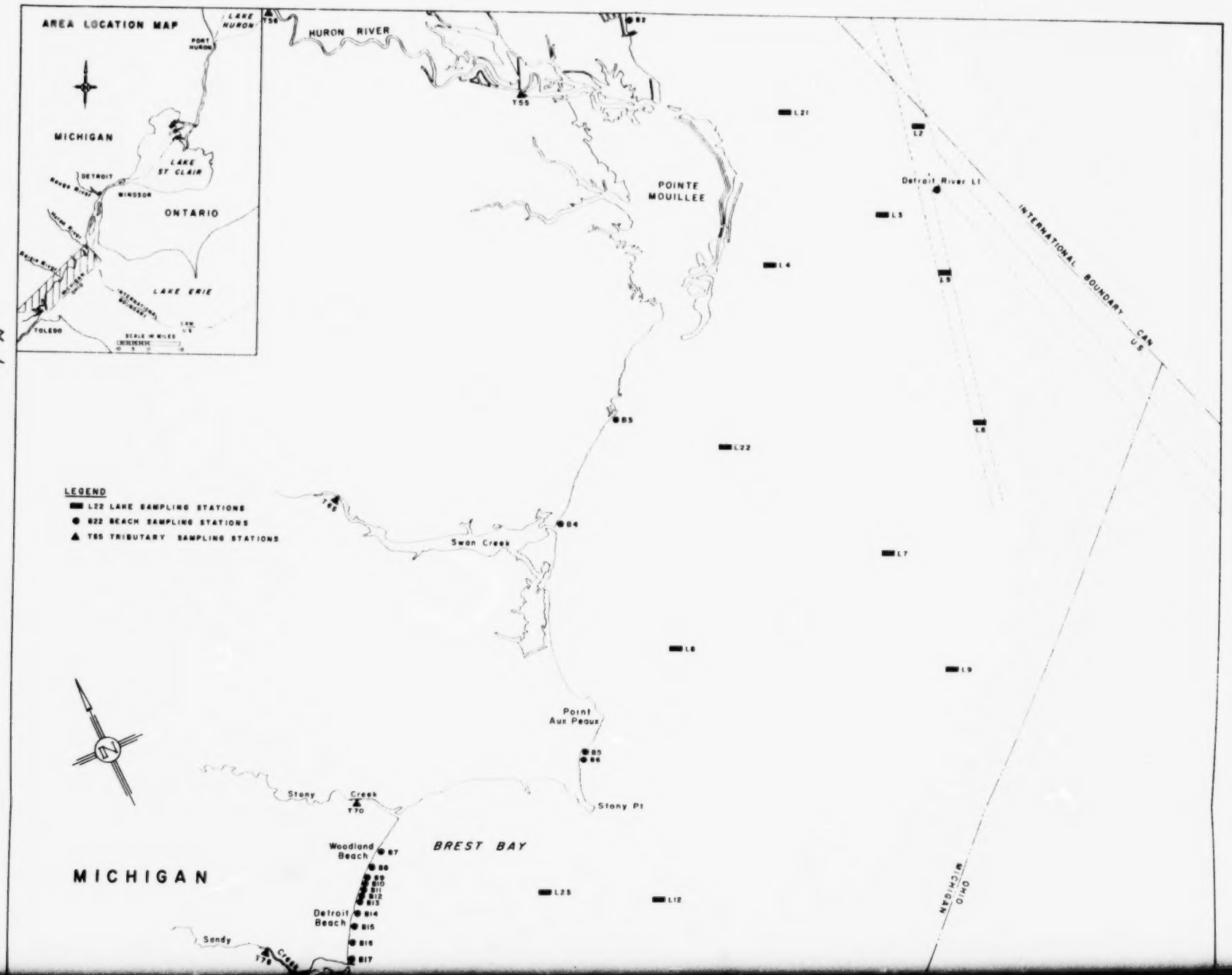

AREA LOCATION MAP
LAKE HURON
PORT HURON
MICHIGAN
LAKE ST CLAIR
DETROIT
RIVER
WINDSOR
ONTARIO
LAKE ERIE
TOLEDO
SCALE IN MILES
HURON RIVER
T56
T55
B2
POINTE MOUILLEE
L21
L2
Detroit River L1
L3
L4
L5
INTERNATIONAL BOUNDARY CAN US
B3
L22
L6
T6
B4
Swan Creek
L7
L8
L9
Point Aux Peaux
B5
B6
Stony Pt
Stony Creek
T70
BREST BAY
Woodland Beach
B7
B8
B9
B10
B11
B12
B13
B14
Detroit Beach
B15
B16
B17
L25
L12
MICHIGAN
OHIO
Sandy Creek
T75
LEGEND
L22 LAKE SAMPLING STATIONS
B22 BEACH SAMPLING STATIONS
T55 TRIBUTARY SAMPLING STATIONS

74

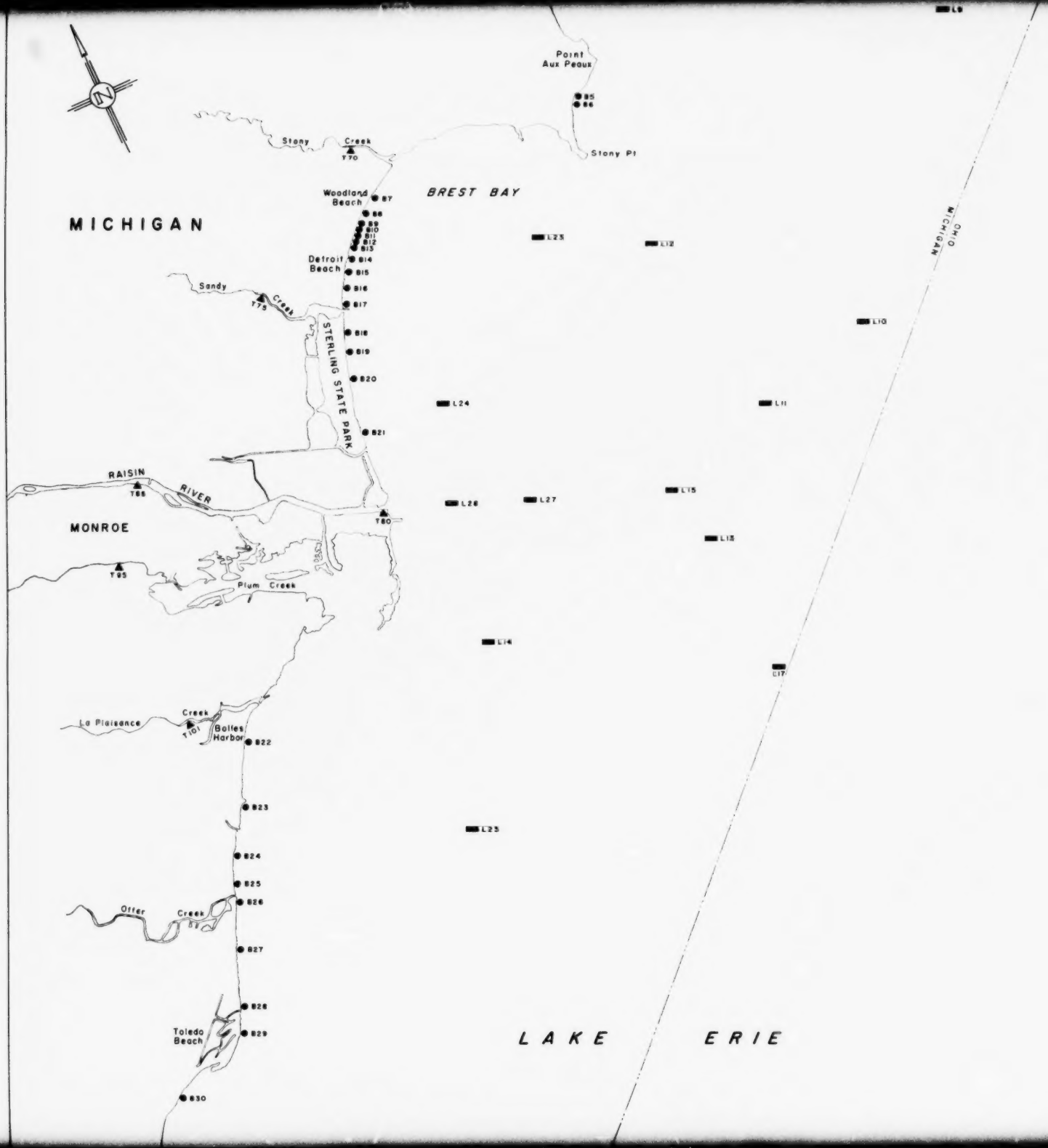
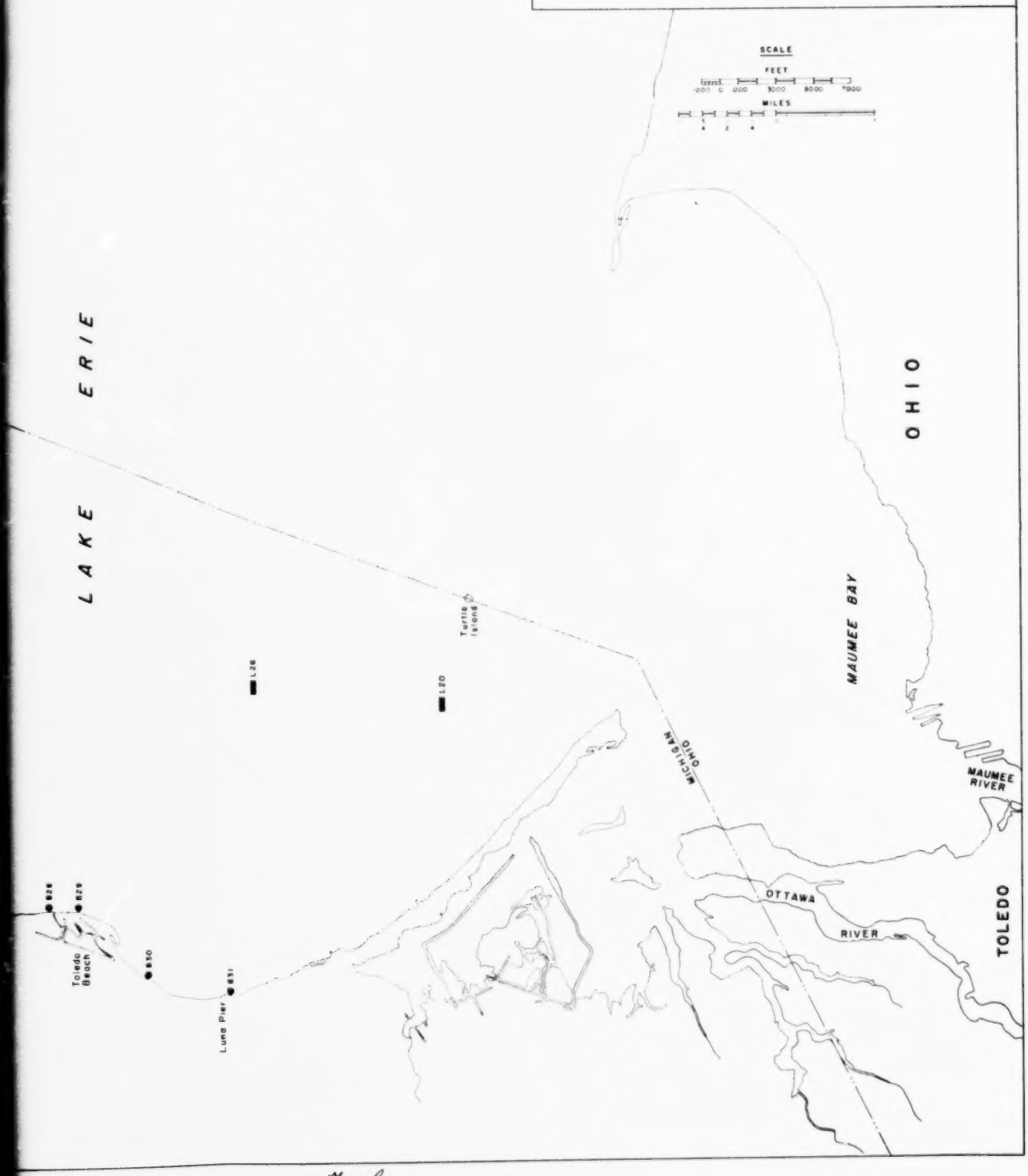

Point Aux Peaux
B5
B6
Stony Creek
T70
Stony Pt
BREST BAY
Woodland Beach
B7
B8
B9
B10
B11
B12
B13
Detroit Beach
B14
B15
B16
B17
B18
B19
B20
B21
MICHIGAN
Sandy Creek
T75
STERLING STATE PARK
RAISIN RIVER
T85
MONROE
T80
T95
Plum Creek
La Plaisance Creek
T101
Bolles Harbor
B22
B23
B24
B25
B26
Otter Creek
B27
B28
B29
Toledo Beach
B30
L23
L12
L10
L24
L11
L15
L26
L27
L13
L14
L17
L25
L9
OHIO
MICHIGAN
LAKE ERIE

FIGURE 3-I

DETROIT RIVER-LAKE ERIE PROJECT

LOCATION OF SAMPLING STATIONS
MICHIGAN WATERS OF LAKE ERIE

U.S. DEPARTMENT OF HEALTH, EDUCATION, AND WELFARE
PUBLIC HEALTH SERVICE
REGION V GROSSE ILE, MICHIGAN



domestic and industrial installations. Composite sampling for a continuous period coupled with waste discharge measurements acted as controls to the special surveys.

Seasonal bottom fauna studies were made in the Detroit River to determine both the presence and number of biological organisms in the bottom deposits, and the effect of waste sources on these organisms. At the same time physical and chemical measurements were made in the waters under study to correlate with biological observations. In addition to the bottom fauna studies, plankton organisms were collected routinely.

Sampling Technique

Samples were collected in a special scoop sampler designed to hold a half-gallon glass bottle for future chemical and physical analysis and a small sterile bottle for bacteriological analysis. This technique eliminated the necessity for pouring from sampler to bottle and allowed both the bacteriological and chemical sample to be collected simultaneously. Standard equipment was used for the collection of samples to be analyzed for biologic specimens and dissolved oxygen. Accepted engineering and biologic techniques were used in the collection of these samples. Whenever applicable, procedures described in "Standard Methods" were followed, especially those limiting the elapsed time from collection to analysis.

Sampling Analysis

After collection the samples were taken to the receiving room of the Project laboratory. Samples for bacteriological analysis were taken to this section of the laboratory for immediate processing and incubation. Samples for chemical analysis were divided into aliquots to expedite the testing program. Special preparation or preservation was required for certain chemical analyses. At this time samples for analyses requiring special laboratory equipment were mailed to the Great Lakes-Illinois River Basin Project laboratory in Chicago.

All laboratory procedures were performed in accordance with "Standard Methods". Minor modifications were made on two determinations--ammonia nitrogen and organic nitrogen--to improve the sensitivity and expedite a systematic analytical scheme. Before adopting these modifications a thorough study was made to evaluate the impact of the change. After analysis the results were recorded on combination laboratory and data sheets and forwarded to a separate evaluation section.

Bacteriological Analysis

All water samples collected for bacterial study were examined for total coliform content by the Membrane Filter (MF) technique described in "Standard Methods", using lauryl sulfate tryptose broth. A Most Probable Number (MPN) test by multiple tube dilution was used as an occasional check against the MF technique. Fecal streptococcus determinations were made using the MF technique as described in "Standard Methods". KF Streptococcus Agar (Difco No. 0496-01) was used in place of M-enterococcus Agar.

Fecal coliform populations were estimated by inoculating sheen colonies from the total MF plates directly into fermentation tubes of EC Medium (Difco No. 0314-01), one colony per tube of medium with incubation in a water bath set at 44.5 - 45° C for 24 (±) 2 hours. The number of colonies picked ranged from 10 to 20 per sample. If 10 colonies were picked and none was positive, the result was recorded as "10%". If none of 20 colonies was positive, the result was recorded as "5%". This test is termed a temperature differential test. The presence of gas in the fermentation tubes indicates that the coliforms present originated from the gut of warm-blooded animals (fecal coliforms). Absence of gas indicates the absence of fecal coliforms, since coliforms derived from non-fecal sources generally fail to produce gas at 44.5 - 45° C. Mr. Harold F. Clark of the Robert A. Taft Sanitary Engineering Center advised with regard to procedures, preparation of media, incubation of cultures, and tabulation of results.

Over 100 duplicate samples were analyzed for coliform density by both MF and MPN techniques; in all but two cases the membrane filter result was within the 95% confidence limit of the corresponding MPN result. The MF results were consistently lower than corresponding MPN determinations, especially in lower coliform densities. Nine samples representing degrees of bacterial densities common in relatively unpolluted river water were collected and ten replicates were analyzed for total coliform organisms by both the MPN and membrane filter technique. The MF results were again lower than corresponding MPN determinations, with the expected differential.

Data Evaluation

Results of laboratory analyses and field activities were tabulated and statistically summarized by a separate Engineering Evaluation Section using electronic data-processing facilities. The results of the evaluation in the early stages of Project operation furnished guidelines for future sampling activity. By considering several statistical descriptions of data collected early in Project operation, it was possible to eliminate many sampling stations that furnished duplicate or nearly duplicate results.

Dr. Richard D. Remington, Professor of Biostatistics at the University of Michigan, reviewed statistical procedures and recommended, when appropriate, additional or alternate methods of evaluation. He also used complex statistical approaches to check the reliability of Project technical data and assure its maximum use.

Dr. Lawrence Polkowski, Professor of Sanitary Engineering at the University of Wisconsin, assisted in formulating statistical procedures and in the studies of pollution from shorefront homes and unsewered communities.

Special Investigations

Bacterial regrowth in the receiving stream after discharge from the Rouge River and the Detroit Sewage Treatment Plant was studied specifically, with negative results. The investigation showed neither significant regrowth or die-off of coliform population in the Detroit River after discharge from these waste sources. The short time of water movement from waste sources to the mouth of the River could have influenced these findings.

Another special investigation was made of the bottom of the waters under study to determine the effect of waste sources upon this area of the environment. Bottom sediment samples were collected at one-mile grids in Lake Erie and regular intervals in the Detroit River. These samples were analyzed for significant chemical and physical constituents and samples above waste sources compared with those below.

To evaluate the effects of particular waste sources upon water quality, a familiarity with currents in the Detroit River and Lake Erie was necessary. Fluorescent dye was placed in waste sources and traced.

Effects of discharges from combined sewers during or following significant rainfall were the subject of another special study. The waters under study were sampled during and following heavy rains and the results compared statistically with dry-weather sampling. Results of other investigations in the past were examined to see if significant variation in water quality could be expected downstream from outfalls of combined sewers. Later a second study was conducted by the State regulatory agencies and the Public Health Service in cooperation with two municipalities. These results were correlated with rainfall intensity in the drainage area. A special report on this study has been compiled by the Michigan Department of Health.

During the operation of this Project, several unusual circumstances occurred which merit special mention. One such is the by-passing to the Detroit River for 10 days of a substantial percentage of the domestic wastes from the City of Detroit sewerage system. This action was required to replace sluice gates in a major pumping station in the system. Since advance notice of this action was given, it was possible to design and carry out a special sampling program which furnished a great deal of insight into the effect of domestic waste on water quality at different locations in the Detroit River and Lake Erie.

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ACKNOWLEDGEMENTS

During the preparation of this report, valuable assistance has been rendered by a great number of individuals and representatives of private groups and governmental agencies.

The extensive participation of the Michigan Water Resources Commission and the Michigan Department of Health in the conduct of the Project was an essential part of this State-Federal undertaking.

Laboratory and administrative assistance and industrial and demographic projections were furnished by the Great Lakes-Illinois River Basins Project of the Public Health Service. In turn, information collected by the Detroit Project will be utilized by the Great Lakes Project in their comprehensive study of the Great Lakes Basins.

Staff of the Robert A. Taft Sanitary Engineering Center furnished guidance and assistance in the preparation of the portion of this report on biology.

Special acknowledgement for important contributions must go to the following agencies and organizations:

International

International Joint Commission

Federal

U.S. Coast Guard

U.S. Corps of Engineers
Detroit District Office
Lake Survey

U.S. Department of Commerce,
Weather Bureau

U.S. Department of Interior
Bureau of Commercial Fisheries
Geological Survey

U.S. Navy

U.S. Department of Health, Education, and Welfare,
Public Health Service
Robert A. Taft Sanitary Engineering Center, Cincinnati, Ohio
Great Lakes-Illinois River Basins Project, WS&PC, Region V, Chicago, Illinois

State of Michigan Agencies

Michigan Department of Conservation
Michigan Department of Health
Michigan Water Resources Commission

Regional Agencies

Regional Planning Commission - Detroit Metropolitan Area
Supervisors Inter-County Committee

County Agencies

Monroe County Health Department
Washtenaw County Health Department
Wayne County Health Department
Wayne County Road Commission

Municipal Agencies

City of Ann Arbor
City of Detroit
City Planning Commission
Department of Health
Department of Public Works
Water Department
City of Monroe
Port of Monroe Authority
City of Trenton
City of Wyandotte
Municipal Service Commission

Universities

Central Michigan University
Department of Biology

Ohio State University
Franz Theodore Stone Laboratory

University of Michigan
Great Lakes Research Division
School of Natural Resources, Department of Wildlife Management
Museum of Zoology, Mollusk Division
School of Civil Engineering
School of Public Health

Others

Great Lakes Fisheries Commission

National Sanitation Foundation

Grateful acknowledgement is also made to the many others, too many to name, whose help made this study possible.

BACKGROUND

Other Investigations

Many investigations of water resources have been made in the Detroit area. Some dealt with one specific problem while others investigated water pollution in general and the effect on water quality of various waste sources. These studies have been conducted by governmental units at all levels, universities, and consulting engineers. Four such undertakings will be discussed here to provide background for the investigations, findings, and conclusions of the Detroit River-Lake Erie Project.

Investigation by the International Joint Commission, 1913

Following the Boundary Waters Treaty of 1909 between the governments of Canada and the United States, a field investigation was made of the bacteriological quality of certain international waters, including the Detroit River. Bacteriological techniques and methods of reporting differed from modern practices, but the report is invaluable in furnishing data on water quality at this early date, prior to sewage treatment in the area. Findings included:

(a) Bacterial densities changed markedly from the head of the Detroit River to its mouth, increasing from less than 5/100ml at the head to 11,592/100ml at the mouth.

(b) High bacteriological densities were most pronounced close to each shore.

(c) No sewage treatment was provided, with numerous outfalls along the River Rouge and both shores of the Detroit River.

(d) Sampling of bathing beaches near Grosse Ile indicated constant gross pollution.

(e) The Detroit River from Fighting Island to its mouth was unfit for a source of drinking water with any known method of water purification. Three communities were, however, using the River in this area as a source of domestic supply.

Any reader of the report should consider the date it was written and the status of sanitary engineering technology at that time. Since 1913 sewage treatment facilities have been installed at most locations, and water treatment technology has progressed to the point where raw water of higher bacterial density can be treated with safety, so long as there is no operational failure.

Results were reported as an index per 100 ml rather than an actual colony count as in more modern techniques. A crude approximation of comparable MPN values may be obtained by multiplying the index by 2.4.

In the latter part of May 1913, ten daily samples were collected from each of ten stations across the Detroit River near its mouth, and the average coliform index during this period was 11,592 per 100ml. In September 1913, 15 samples were collected from each of 14 stations across the Detroit River near its mouth. The average index from this sampling was 1,757 per 100 ml. The difference may be due to seasonal changes, uneven choices of sampling stations, or variableness of waste discharges.

The report emphasized the urgent need for effective sewage treatment in the area and the bacterial deterioration of the Detroit River from head to mouth.

Fox Creek Drainage Report, 1948

A board of consulting engineers, consisting of Samuel A. Greely, Malcomb Pirnie, and William Storrie, prepared this report for the City of Detroit to evaluate the effect of combined sewer overflows into the Detroit River upon the City's raw water supply.

The findings of the Board regarding the quality of raw water at the Detroit Water Works intake are summarized below:

(a) Pollution of Lake St. Clair and the Detroit River has increased over the years, and this is reflected at the municipal water intakes.

(b) Despite increasing pollution, the raw water at Detroit is better than that at several of the large Great Lakes cities and is readily amenable to treatment by methods commonly used in practice today.

(c) The maximum M.P.N. in any sample of recent years was 15,000 per 100 c.c. and the maximum daily average was 7,030 per 100 c.c.

(d) For the most part the high M.P.N. values follow rains and are accompanied by recognizable increases in turbidity.

(e) Minor increases in coliform density are frequent, with or without any unusual rainfall, and usually are accompanied by small changes in turbidity or chlorine demand.

The report described several sources of pollution and how they affect the characteristics of the raw water:

A. FOX CREEK. Of the several sources, Fox Creek will cause the most serious trouble if permitted to discharge increased pollution. At the present time, the sewage discharged into Fox Creek is limited to excess combined flows from Grosse Pointe Park not exceeding 800 c.f.s., and the effects have not been severe. However, float tests have demonstrated that under certain conditions water from the mouth of Fox Creek at Windmill Point will reach the intake. Thus the discharge of sewage into Fox Creek at any time is undesirable.

B. CONNER CREEK. There is considerable evidence of pollution of the Belle Isle bathing beaches from Conner Creek, but very little to indicate serious pollution of Detroit raw water since the new intake was completed in 1932. The inlet to the intake lagoon is 1,000 feet below Conner Creek, on the opposite side of the United States channel. A very strong wind from the west or northwest might overcome the natural direction of surface water flow downstream and force surface water across the channel to the intake. However, there is no record of such an occurrence and the new intake, purposely located upstream to avoid pollution from Conner Creek, has served well.

The report described the dangers involved in the proposed discharge of combined sewage through Fox Creek as follows:

If the proposed Fox Creek sewer should be allowed to discharge any combined sewage through Fox Creek, the effect on the Detroit water supply would be damaging and perhaps disastrous.

To remove the dangers of such pollution, the discharge of untreated sewage through any existing or future outlets upstream of Conner Creek should be prohibited. To accomplish this, the Board favors the adoption of a comprehensive plan based largely on the installation of separate sewers.

The Board made several recommendations to the City of Detroit. Nine of these have been selected as pertinent background to the present study.

These are: . . .

8. Lake Huron will become essential as a source of water supply only if pollution within practicable limits in Lake St. Clair and its tributary waters is not controlled.

9. The water works intake at the east end of Belle Isle is well located and should be the source of raw water supply for many years. It is the safest and most economical location in the upper Detroit River and Lake St. Clair. The necessity for moving to another location will arise only if the 'upstream' population increases far beyond the present estimates, or if the pollution of the waters of Lake St. Clair and the Detroit River is not adequately controlled and the quality of these waters is further deteriorated.

10. The characteristics of the present raw water supply do not constitute an unreasonable burden on water purification facilities as compared to other large water purification plants on the Great Lakes.

12. The capacity of the water works chlorinating equipment should be increased and provision should be made for prechlorination at the intake shaft on Belle Isle.

13. Adequate control of all factors causing or likely to cause pollution of the water supply requires that discharge of untreated sewage through the existing and future outlets upstream from Conner Creek and along the west shore of Lake St. Clair and Anchor Bay be entirely prohibited. There should be no discharge of untreated sewage at Fox Creek.

14. Immediate steps should be taken to modernize equipment in the Fairview Pumping Station.

15. More effective regulations and control should be instituted by the proper authorities over the discharge of sewage and oil from vessels using these waters.
. . .

21. To provide data for planning and guidance for safe operation, it is recommended that routine and regular samples of the waters related to the Fox Creek problem be taken and analyzed. Sampling stations should be selected in the head waters of the Detroit River and at several points in Lake St. Clair as far north as Anchor Bay where, throughout the year, so far as practicable, samples should be taken and analyzed at regular intervals, and the trend of the quality of the raw water recorded. In the selection of sampling points, consideration should be given to those used by the International Joint Commission in its 1947 survey.

22. The water recreation afforded to the Metropolitan Area by Lake St. Clair and the upper reaches of the Detroit River is unique and invaluable. An adequate control of the several sources of pollution together with a comprehensive plan for sewerage and sewage disposal are essential to the safeguarding of these waters.

IJC Report on Pollution of Boundary Waters. 1951

During the period 1946-48 the International Joint Commission made a special survey of pollution in international waters. Requested to do so in April 1946 by the governments of Canada and the U.S.A., the Commission was charged with answering four basic questions:

1. Are the waters referred to in the preceding paragraph, or any of them, actually being polluted on either side of the boundary to the injury of health or property on the other side of the boundary?

2. If the foregoing question is answered in the affirmative, to what extent, by what causes, and in what localities is such pollution taking place?

3. If the Commission should find that pollution of the character just referred to is taking place, what measures for remedying the situation would, in its judgment, be most practicable from the economic, sanitary, and other points of view?

4. If the Commission should find that the construction or maintenance of remedial or preventive works is necessary to render the waters sanitary and suitable for domestic and other uses, it should indicate the nature, location, and extent of such works and the probable cost thereof, and by whom and in what proportions such cost should be borne.

Field investigations determined the present condition of the waters under study (which included the Detroit River) from the standpoint of 16 measures of water quality. Waste sources were qualitatively and quantitatively investigated, as well as physical features of the rivers including discharge and transboundary movement of pollution. Major uses of the waters and the effect of pollution upon these uses were described. A summary of the finding and recommendations is given below:

1. These waters are seriously polluted in many places on both sides of the boundary. The most serious pollution exists in the St. Clair River below Port Huron and Sarnia, in Lake St. Clair along the west shore, in the Detroit River below Belle Isle, and in Lake Erie's west end. There is progressive over-all degradation of the water between Lake Huron and Lake Erie.

2. There is a transfer of pollution from each side of the boundary to the other. This has been demonstrated by float studies, by analytical results, and by accidental discharges of specific substances.

3. There has been injury to health and property on both sides of the boundary. This has been manifested in the following ways:

a. Health. A potential menace is present where these polluted waters are used for domestic purposes. They are in such condition that they cannot be safely used as a potable supply without complete and continuously effective treatment. Much of the threat to health arises from such factors as bacterial overloading beyond the safe limits of water purification processes; variations in pollution with accompanying erratic chlorine demand; interference of certain types of pollution with disinfectants; and the probability of certain infections being carried through a water treatment process, especially if there is any interruption or breakdown in a part of that process. This danger was realized in Detroit in 1926 when 45,000 cases of dysentery were reported among the water consumers.

These waters are so polluted in many areas as to render them unsafe for bathing purposes. Both warning and prohibitory actions in this respect have been taken by appropriate authorities. Case histories of some typhoid fever patients in Detroit have pointed strongly to infections contracted at a Lake St. Clair beach. This damage is not only reflected in cases of typhoid fever and other reportable diseases, but it may include enteric, ear, and upper respiratory infections.

The sewage pollution present in these boundary waters must be considered as an actual and potential health hazard, whether it be through public water supplies, bathing beaches, or other means. If the 1913 to 1948 trend in water pollution is permitted to continue the time will come when it will be impossible to use these waters safely for domestic purposes.

b. Property. Injury to property has been illustrated in the cost of extending water intakes and of water treatment, both for municipalities and industries; in

economic loss to owners of bathing beaches and other waterfront property; in damage to water craft; and in destruction of fish and wildlife.

c. Industry. There is evidence that these waters are polluted to such a degree as to affect their use in certain industries. An economic loss to the community and to industry as well will occur when a plant is unable to locate in an area because of inability to secure a satisfactory water supply.

4. Substantial progress has been made in control or elimination of pollution during the period of this investigation. Both municipalities and industries have contributed to this activity. Municipal progress has been confined largely to the planning stages, whereas industry has advanced many of its programs to the construction stage. As a result of improved control of industrial waste discharges taste difficulties in municipal water supplies were much less pronounced at the conclusion of this study than prior to 1946.

5. Public hearings held by the Commission revealed a common acceptance on the part of municipal officials and industrial management of the presence of serious pollution in these waters and the need for correction. The hearings also substantiated the findings of the Advisory Board that there was injury to health and property and interference with the various water uses on both sides of the boundary. Financing of the necessary remedial works was asserted by municipal officials to be the principal obstacle to correction.

6. Frequent releases of pollution in the form of slugs or spills create intensified injury to the users of these waters and cause acute difficulties in water purification plants.

7. The condition of these waters requires that remedial measures be undertaken as early as possible.

The Advisory Board respectfully recommends to the Commission that:

1. Remedial measures for the abatement and control of pollution in the Lake Huron-Lake Erie section of the boundary waters be undertaken at the earliest possible date. These measures should be sufficient to restore and protect the uses of these waters to which the people of both countries are rightfully entitled. Major consideration should be given to uses for domestic and industrial water supplies, recreation, fish and wildlife, sanitary purposes, and navigation.

2. The "Objectives for Boundary Water Quality Control," prescribed in this report, be recognized in the development of remedial and pollution-preventive measures by municipalities and industry. These objectives should apply to both existing and new sources of wastes.

3. Treatment of municipal wastes by sedimentation and disinfection of the effluent be undertaken by all communities as the initial step; that a program of more efficient or secondary treatment be inaugurated at as early a date as possible; and that a median coliform M.P.N. value not exceeding 2,400 per 100 ml as set forth in the "Objectives for Boundary Water Quality Control" at dilution of waste discharges be considered as the objective for bacterial control to attain reasonable stream sanitation. The more efficient or secondary treatment recommended will be most urgent in those zones of concentrated discharge near large centers of population or where much industrial waste is involved. It is recognized that local conditions, on either side of the boundary, may give additional emphasis to the need for this higher degree of treatment. The estimated cost for installation of intercepting sewers and primary treatment works for municipalities in the section is $51,000,000, of which $35,000,000 is for United States and $16,000,000 for Canadian communities. For the additional cost of secondary treatment of municipal wastes the estimate is

$37,000,000, of which $33,000,000 is on the United States side and $4,000,000 on the Canadian side. These works must be financed through public funds.

4. Overflows from combined sewers during storm periods be treated by sedimentation and disinfection or by other methods where necessary to protect the purposes for which these waters are or may be utilized.

5. Industrial wastes be treated to comply, as soon as possible, with the "Objectives for Boundary Waters Quality Control." The estimated cost for industrial waste treatment works is $16,000,000, of which $13,000,000 is for United States and $3,000,000 for Canadian industries. The correction and prevention of pollution resulting from the disposal of industrial wastes is the responsibility of industry.

6. Slugs and spills of objectionable wastes from industrial plants be avoided. Retention tanks or lagoons for equalizing rates of discharge may be utilized when approved by enforcing authorities where slugs and spills cannot otherwise be controlled.

7. Sewage from vessels equipped with flush toilets and from craft used for living purposes be controlled by the installation of holding tanks, and that the tanks be emptied either by transfer of the contents to shore treatment facilities or disinfected and dumped overboard in nonrestricted areas. No garbage or other refuse be discharged overboard into these waters.

8. Materials from dredging operations be dumped only at locations where they will not interfere with legitimate water uses.

9. Consideration be given to joint community action on metropolitan or regional bases in the effective solution of mutual water and sewerage problems in this section.

10. Definite plans for financing remedial municipal works be formulated. In this, there should be cooperation between the Commission and Federal, State, Provincial, and municipal governments.

11. Continuing contact with pollution control progress be maintained through a technical committee or board having representation from both countries.

12. The Commission take such measures as may be legally available to it to have the pollution abatement and prevention program herein outlined initiated, promoted, and effectively prosecuted.

Two highly significant accomplishments were, first, the establishment of IJC objectives for water quality control and, second, the establishment of a technical committee or board to maintain continuing contact with pollution control. The IJC objectives are listed in Table 2-I, following.

TABLE 2-I. SUMMARY OF IJC OBJECTIVES FOR BOUNDARY WATERS QUALITY CONTROL

General Objectives

All wastes, including sanitary sewage, storm water, and industrial effluents, shall be in such condition when discharged into any stream that they will not create conditions in the boundary waters which will adversely affect the use of those waters for the following purposes: domestic water supply or industrial water supply, navigation, fish and wildlife, bathing, recreation, agriculture, and other riparian activities.

In general, adverse conditions are caused by:

1. Excessive bacterial, physical, or chemical contamination.
2. Unnatural deposits in the stream, interfering with navigation, fish and wildlife, bathing, recreation, or destruction of aesthetic values.
3. Toxic substances and materials imparting objectionable tastes and odors to waters used for domestic or industrial purposes.
4. Floating materials, including oils, grease, garbage, sewage solids, or other refuse.

Specific Objectives*

1. Coliform Organisms - Median MPN: 2400/100ml.
2. Phenolic-type wastes: Average 2 ppb, Maximum 5 ppb.
3. pH: 6.7 to 8.5.
4. Iron: 0.3 ppm.
5. Odor: 8.
6. Unnatural color and turbidity: Shall not be offensive.
7. Oil and floating solids: No adverse effect on water use.
8. Highly toxic wastes: No adverse effect on water use.
9. Deoxygenating wastes: No adverse effect on water use.

Effluent Recommendation to Achieve Specific Objectives

1. Phenolic-type waters: 20 ppb.
2. pH: 5.5 to 10.6.
3. Iron: 17 ppm.
4. Oil: 15 ppm.

*After initial dilution.

Wayne County Water Supply Investigation, 1955

This report, prepared in 1955 by Hazen and Sawyer, Consulting Engineers for the Wayne County Road Commission, investigated possible expansion of the Wayne County Metropolitan Water Supply System to serve the Wayne County area south and west of Detroit. A great deal of water quality data was collected for this survey in the Detroit River and upper Lake Erie during calendar year 1955. Alternate sites and proposals for additional water intake and treatment facilities were considered with respect to cost and quality of water which would be obtained. An intake tower between Grassy Island and Fighting Island was recommended as most suitable.

Three of the conclusions are given below:

4. Previous investigations and the extensive data collected in the past year show that the Detroit River flow effectively shields the mid-river water from shore

pollution, and that water of good quality can be obtained by a properly-located intake between Fort Wayne and Fighting Island South Light.

5. Water of equally good bacterial quality can be obtained from the western end of Lake Erie, but in other respects the Lake water is inferior to the water available from the Detroit River above Fighting Island South Light.

6. While the water in the middle of the Detroit River is remarkably free of shore pollution and Lake Erie water is good, it must be recognized that no water supply from the Detroit River will remain satisfactory unless upstream sewage and industrial waste pollution is controlled by adequate collection and treatment works. We anticipate that the pollution control activity will continue in the Great Lakes - Detroit River area and that disposal facilities will be added as necessary. These steps must be taken to protect existing water supplies and bathing beaches whether or not a new water works intake is built.

Several interesting observations contained in this report pertain to the problems faced by the Detroit River-Lake Erie Project. One is the description of the shore-hugging or streamlined flow phenomenon of wastes after they are discharged into the river. This recognition of lateral stratification in the River is coupled with the remark that there is little cross-flow of water from one side of the River to the other. The report also describes the existence of barometric seiches in Lake Erie which can cause reversal of flow in the Detroit River.

Use of the Wayne County sampling data for selecting an area of the best quality water is of interest. Chloride and coliform concentrations were used as tracers of pollution and as an indication of current distribution in the River and the Lake. The engineers concluded that the most important single source of pollution in upper Michigan Lake Erie was the Trenton Channel of the Detroit River and that the Livingston Channel and the western side of the Amherstburg Channel discharge relatively clean water into the Lake. The report concludes that the only good intake site in Lake Erie for domestic water would be beyond Point Aux Peaux. Maps indicate that coliform densities south of Point Aux Peaux were less than 1,000 per 100 ml. These maps also show the dispersion of high concentrations of coliforms and chlorides from the Detroit River out into Lake Erie for a distance of approximately 4 to 7 miles.

The report refers to high and extremely variable plankton counts in Lake Erie beyond the influence of the Detroit River. It attributes these high counts to nutrients carried into the Lake by the Maumee and Raisin Rivers. The report also refers to serious operation problems at the Monroe water works caused by sudden and severe plankton growths, specifically, filter-clogging from algae. It also mentions the relocation of the Monroe intake (to its present position) in 1950 to obtain water less prone to tastes and odors from algae. The report attributes high turbidity in Lake Erie to algae and, in some areas, to wind action stirring up mud on the shallow bottom.

Another significant statement from the report is quoted below:

"Variations in mid-river coliform densities may be caused by a number of circumstances, but for the most part, high values in the lower Detroit River follow heavy rains, freshets in the Rouge River, and combined sewer overflows."

Graphs in the report pursue this point by showing coliform results during wet and dry periods on logarithmic probability paper. At the west shore location of a range near Fort Wayne the median coliform density during wet weather was 82 times as great as the median coliform density during dry weather. This effect was less pronounced in mid-channel and at other ranges but at other shore-line sampling points the ratio of wet weather median densities to dry weather values was more than 7 to 1. Probability plots revealed two distinct log-normal distributions for coliform densities during wet and dry periods.

The report draws three conclusions on coliform densities during wet and dry periods:

1. While the coliform density in the mid-river water is greater following rains than in dry weather, the relative increase is small.

2. Shore pollution does not make its way across the river in concentrated slugs. The pollution that reaches the main stream is mixed with a large volume of water and diluted many times.

3. The effect of shore pollution on mid-river water quality increases moderately with distance down the Detroit River as far as Fighting Island South Light; below Fighting Island South Light the effect is greater.

The report describes a special depth study which was performed to determine the validity of using surface samples to represent the bacterial quality of the water. This study indicated sufficient similarity of surface to deep waters to permit the use of surface sampling as representative of bacterial water quality. This conclusion agrees with a similar study performed by the Detroit Project in 1962 for bacterial, chemical, and physical measures of water quality.

Principal sources of pollution are described in the report and include industrial waste discharges into the St. Clair River, combined sewer overflows into the Detroit River from Conners Creek to Trenton, effluents from the Detroit, Dearborn, and Wayne County Sewage Treatment Plants, raw sewage from Windsor and Amherstburg, Ontario, and wastes from industrial plants on both sides of the Detroit River and on the Rouge River.

The report recommends that the Michigan Water Resources Commission continue its pollution control program and that the Commission take steps to see that on the United States side of the international boundary the following are accomplished:

1. Municipal sanitary sewage is to receive adequate treatment.

2. Sewage treatment plants and interceptors are to be constructed for the growing suburban areas around Detroit to minimize combined sewer overflows, particularly where the results of such overflows may affect the quality of water used for municipal supplies.

3. Adequate sewage disposal facilities are to be provided on Belle Isle.

4. Industries are to install facilities to prevent the discharge into the Detroit River of oil and unsightly materials, and phenols and other taste-producing substances where such wastes affect the potability of water used for municipal purposes.

The report also states that: "The City of Detroit should provide adequate chlorination of the effluent leaving the plant."

The report warns that the mid-stream quality in the upper part of the Detroit River may not remain satisfactory indefinitely if upstream pollution is allowed to increase without control.

Another important statement from this report is quoted below:

If pollution of the Trenton Channel and possibly the lower Huron River is allowed to go unchecked, the water at Monroe is almost certain to suffer. Actually, it is reasonable to believe that severe degradation will not be permitted and that the State Water Resources Commission will intervene to protect Lake Erie water.

City of Detroit Sampling Program

The City of Detroit has been determining total coliform densities in the Detroit River from prior to the construction of the Detroit Metropolitan Sewage Treatment Plant in 1941. Ranges were selected above and below the point of discharge of plant effluent. Median counts were determined and plotted on semi-logarithmic graph paper. Figures 5-I through 10-I were taken from graphs prepared by the City and depict trends in this measure of water quality from 1959 through 1963. The International Joint Commission boundary waters objective of 2,400 coliform organisms per 100 ml is also shown on the six graphs. Figure 4-I shows a location map for the sampling ranges.

While the median value for coliform organisms is accepted as a reasonable measure of central tendency of occurrence, it certainly tends to mask unusually high or low values. There appears to be a pronounced downward trend in coliform densities in American waters near the shore, especially during the years 1962 and 1963. Additional comments on trends in water quality in the water under study will be made in Section V of this report.

Water and Sewage Treatment Plant Operating Records, 1960-1963

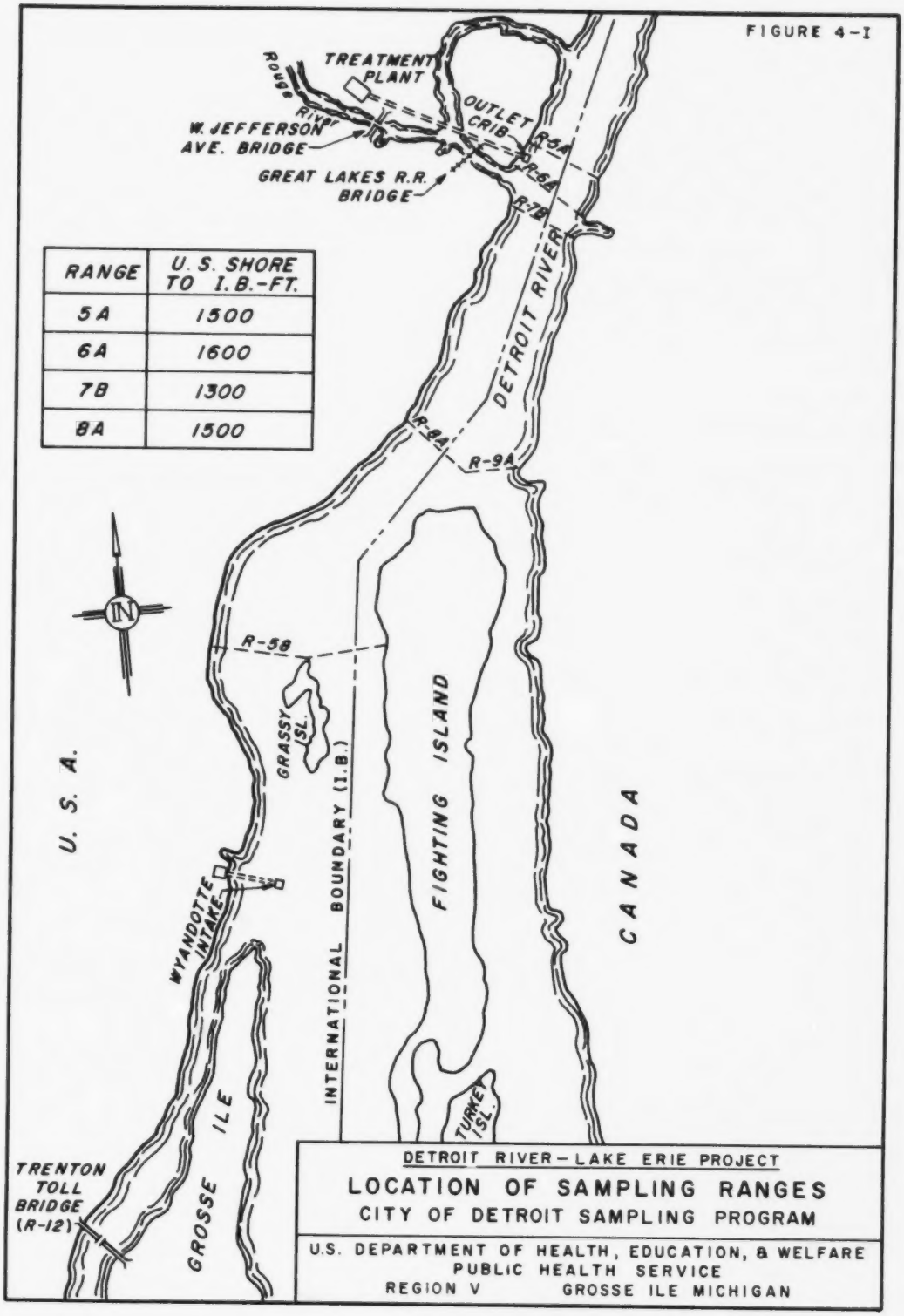
This Project has studied the operating records of several municipal water and sewage treatment plants in the southeast Michigan area. Figures 11-I through 14-I summarize the more significant findings for the period 1960-63, at the Detroit, Wyandotte, Trenton, and Monroe plants. Figure 11-I depicts monthly geometric mean coliform densities in the plant effluents accompanied by maximum and minimum daily geometric means occurring during each month. Figures 12-I and 13-I summarize the monthly geometric mean coliform densities and monthly mean chloride values at the municipal water intakes. Figure 14-I shows the monthly average suspended solids in the effluent and influent of the area sewage treatment plants. The coliform values for the Monroe, Wyandotte, and Trenton Sewage Treatment Plants were available only during those summer months during which the plants chlorinated their effluent.

Figure 11-I indicates a notable reduction in the monthly average total coliform density at all four plants, especially during the years 1962 and 1963. These values are shown on semi-logarithmic paper to allow plotting of maximum and minimum daily averages on the same chart as monthly averages. The maximum daily geometric means are quite erratic and still high.

Figure 12-I shows consistently low total coliform densities at the Detroit intake based on tri-monthly geometric means of the Public Health Service Water Pollution Control Surveillance System station located there. Very little overall change is noted in the monthly coliform levels at the Monroe intake; however, very erratic maximum daily values were observed during this period. A closer look at the Monroe data reveals that total coliform densities at the intake exceeded 2,400 organisms per 100 ml 38 days in 1960, 17 days in 1961, 13 days in 1962, and 21 days in 1963. A significant reduction in the monthly geometric mean coliform densities at the Wyandotte intake was observed during the years 1962 and 1963.

Figure 13-I, showing average monthly chloride concentrations at the Detroit and Monroe intakes, depicts a consistent chloride level at the Detroit intake with all values between the limits of 5 and 9 mg/l and the great majority of values between 6 and 8 mg/l. At the Monroe intake, however, values rose from levels in the range of 30 mg/l in 1960 and 1962 to 40 mg/l in 1963.

Figure 14-I reveals little significant change in effluent suspended solids concentrations and indicates removal efficiency in the general range expected of primary sewage treatment facilities, or approximately 40-60%.



RANGE	U.S. SHORE TO I.B.-FT.
5A	1500
6A	1600
7B	1300
8A	1500

FIGURE 5-I

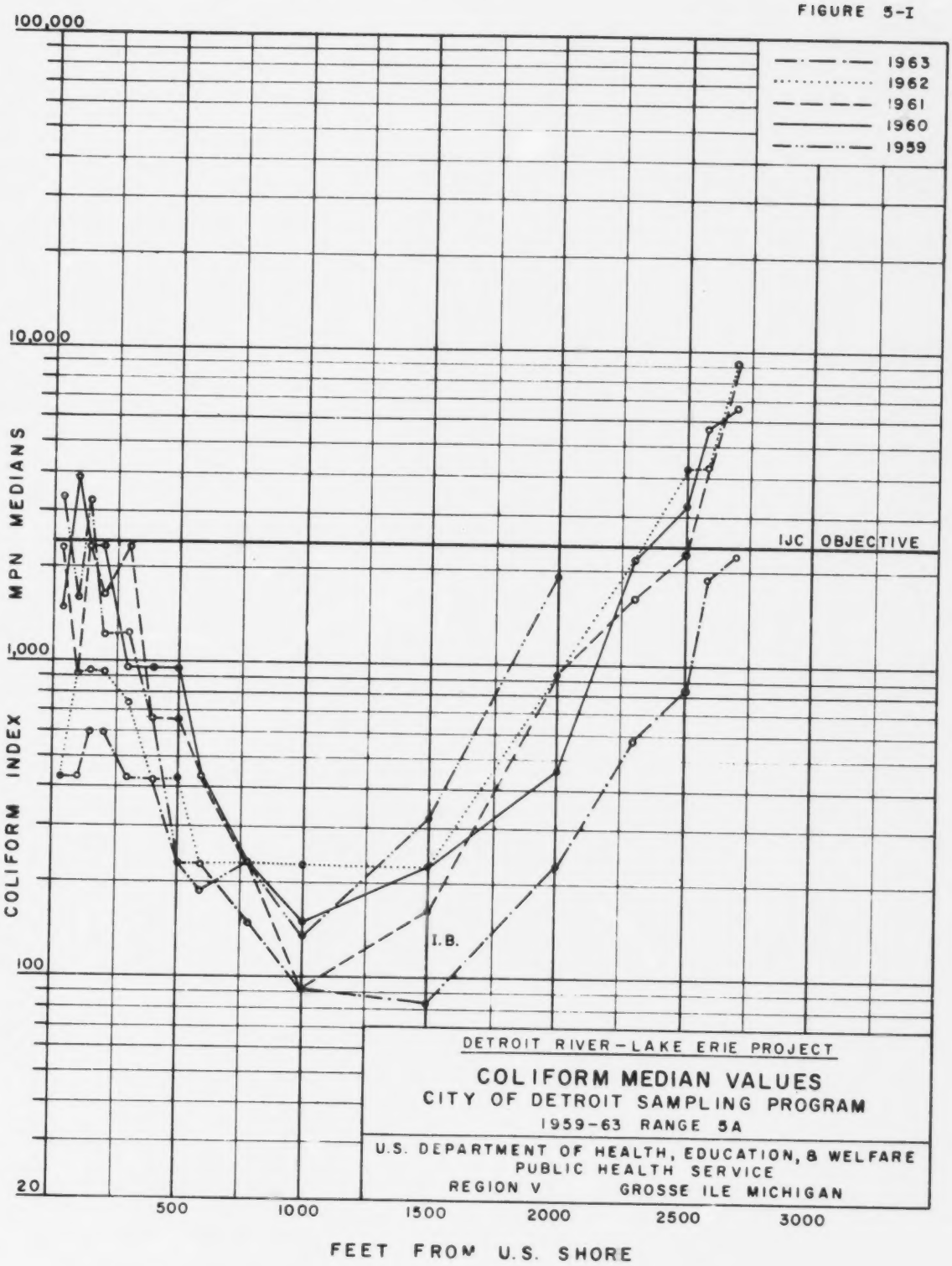

100,000
10,000
1,000
100
20
COLIFORM INDEX MPN MEDIANS
1963
1962
1961
1960
1959
IJC OBJECTIVE
I.B.
500
1000
1500
2000
2500
3000
FEET FROM U.S. SHORE
DETROIT RIVER-LAKE ERIE PROJECT
COLIFORM MEDIAN VALUES
CITY OF DETROIT SAMPLING PROGRAM
1959-63 RANGE 5A
U.S. DEPARTMENT OF HEALTH, EDUCATION, & WELFARE
PUBLIC HEALTH SERVICE
REGION V GROSSE ILE MICHIGAN

FIGURE 6-I

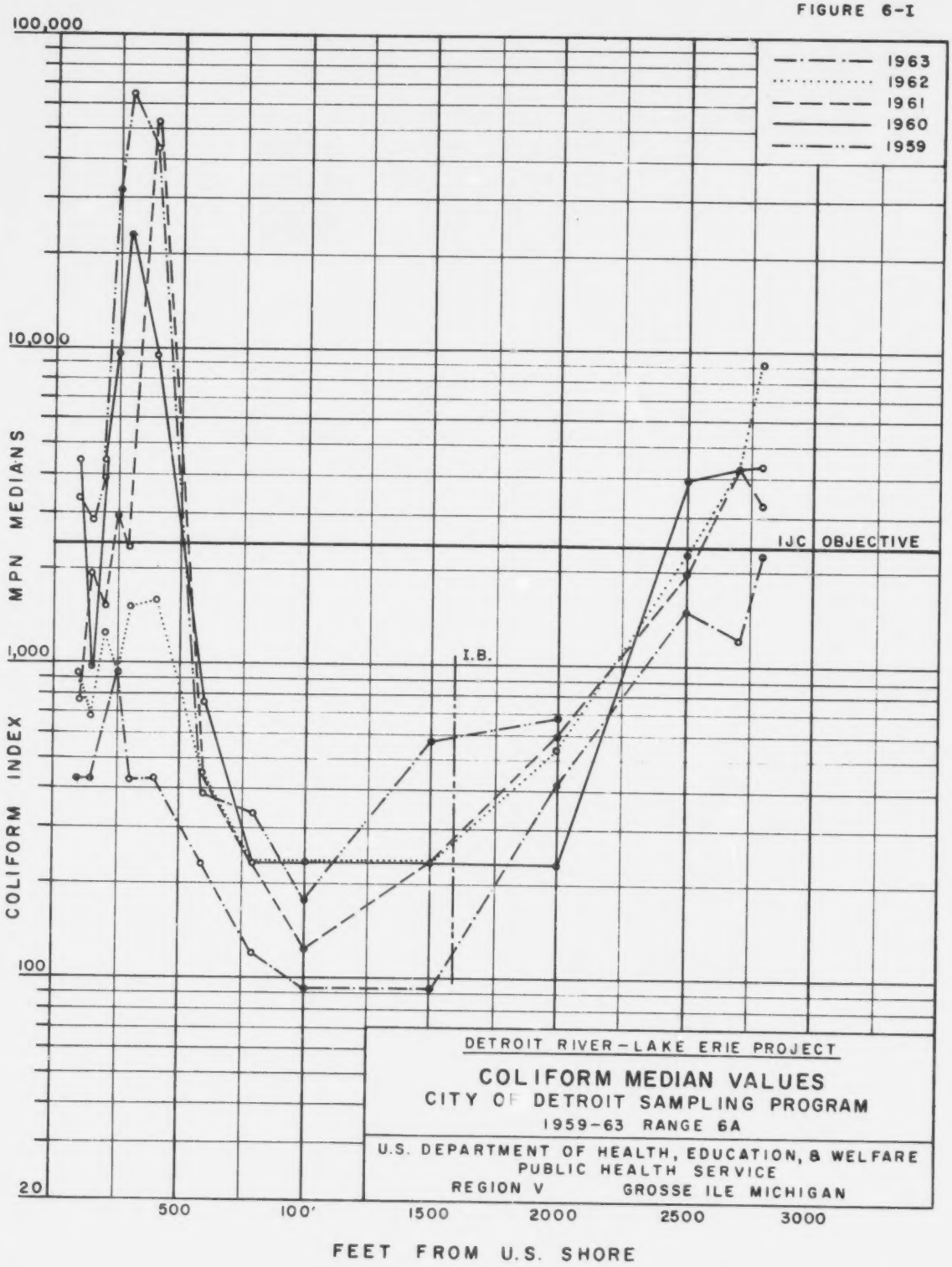

100,000
10,000
1,000
100
20
COLIFORM INDEX MPN MEDIANS
1963
1962
1961
1960
1959
IJC OBJECTIVE
I.B.
500
1000
1500
2000
2500
3000
FEET FROM U.S. SHORE
DETROIT RIVER-LAKE ERIE PROJECT
COLIFORM MEDIAN VALUES
CITY OF DETROIT SAMPLING PROGRAM
1959-63 RANGE 6A
U.S. DEPARTMENT OF HEALTH, EDUCATION, & WELFARE
PUBLIC HEALTH SERVICE
REGION V GROSSE ILE MICHIGAN

FIGURE 7-I

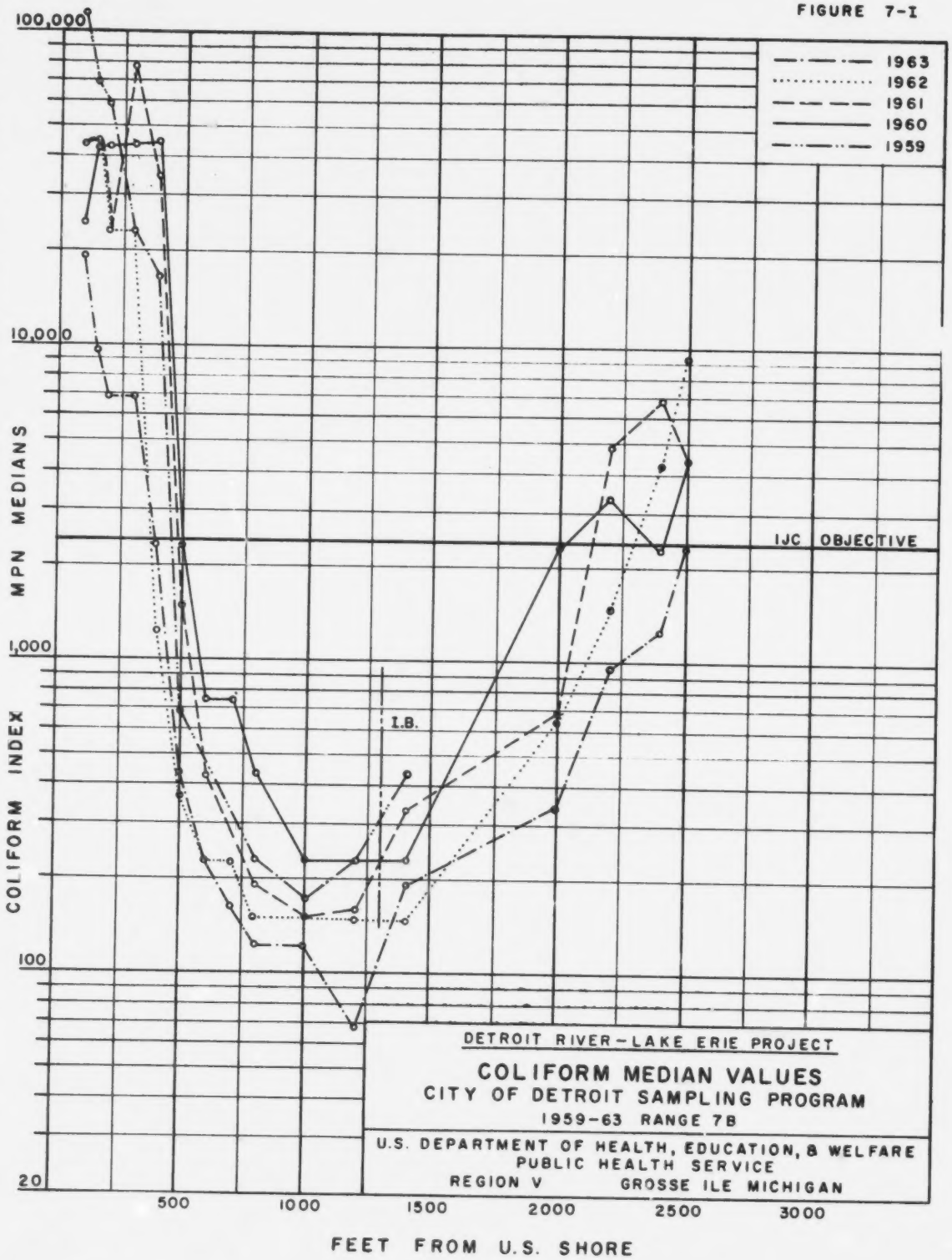

1963
1962
1961
1960
1959
100,000
10,000
1,000
100
20
COLIFORM INDEX MPN MEDIANS
IJC OBJECTIVE
I.B.
500
1000
1500
2000
2500
3000
FEET FROM U.S. SHORE
DETROIT RIVER-LAKE ERIE PROJECT
COLIFORM MEDIAN VALUES
CITY OF DETROIT SAMPLING PROGRAM
1959-63 RANGE 7B
U.S. DEPARTMENT OF HEALTH, EDUCATION, & WELFARE
PUBLIC HEALTH SERVICE
REGION V GROSSE ILE MICHIGAN

FIGURE 8-I

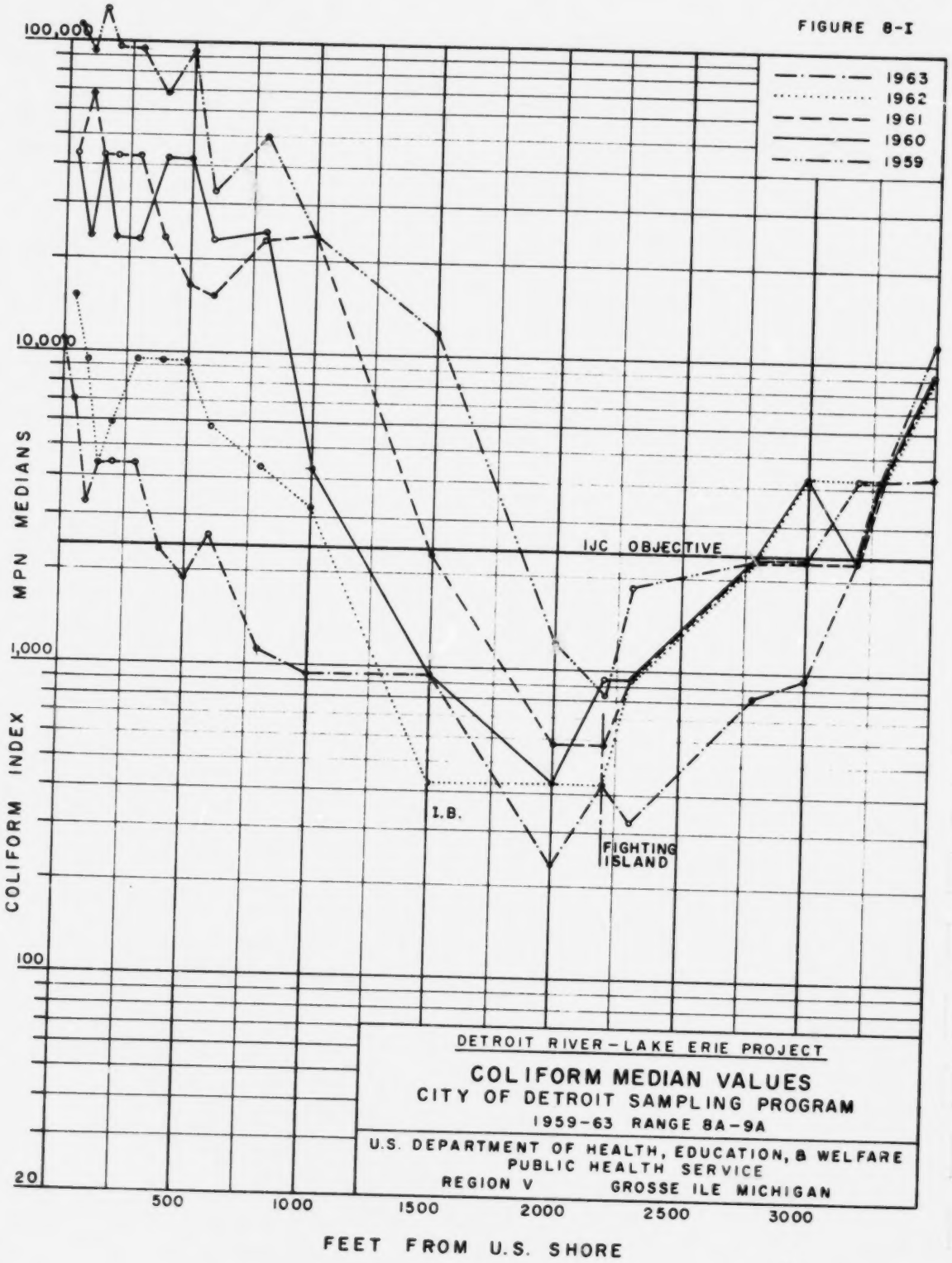

1963
1962
1961
1960
1959
100,000
10,000
1,000
100
20
COLIFORM INDEX MPN MEDIANS
IJC OBJECTIVE
I.B.
FIGHTING ISLAND
500
1000
1500
2000
2500
3000
FEET FROM U.S. SHORE
DETROIT RIVER-LAKE ERIE PROJECT
COLIFORM MEDIAN VALUES
CITY OF DETROIT SAMPLING PROGRAM
1959-63 RANGE 8A-9A
U.S. DEPARTMENT OF HEALTH, EDUCATION, & WELFARE
PUBLIC HEALTH SERVICE
REGION V
GROSSE ILE MICHIGAN

FIGURE 9-I

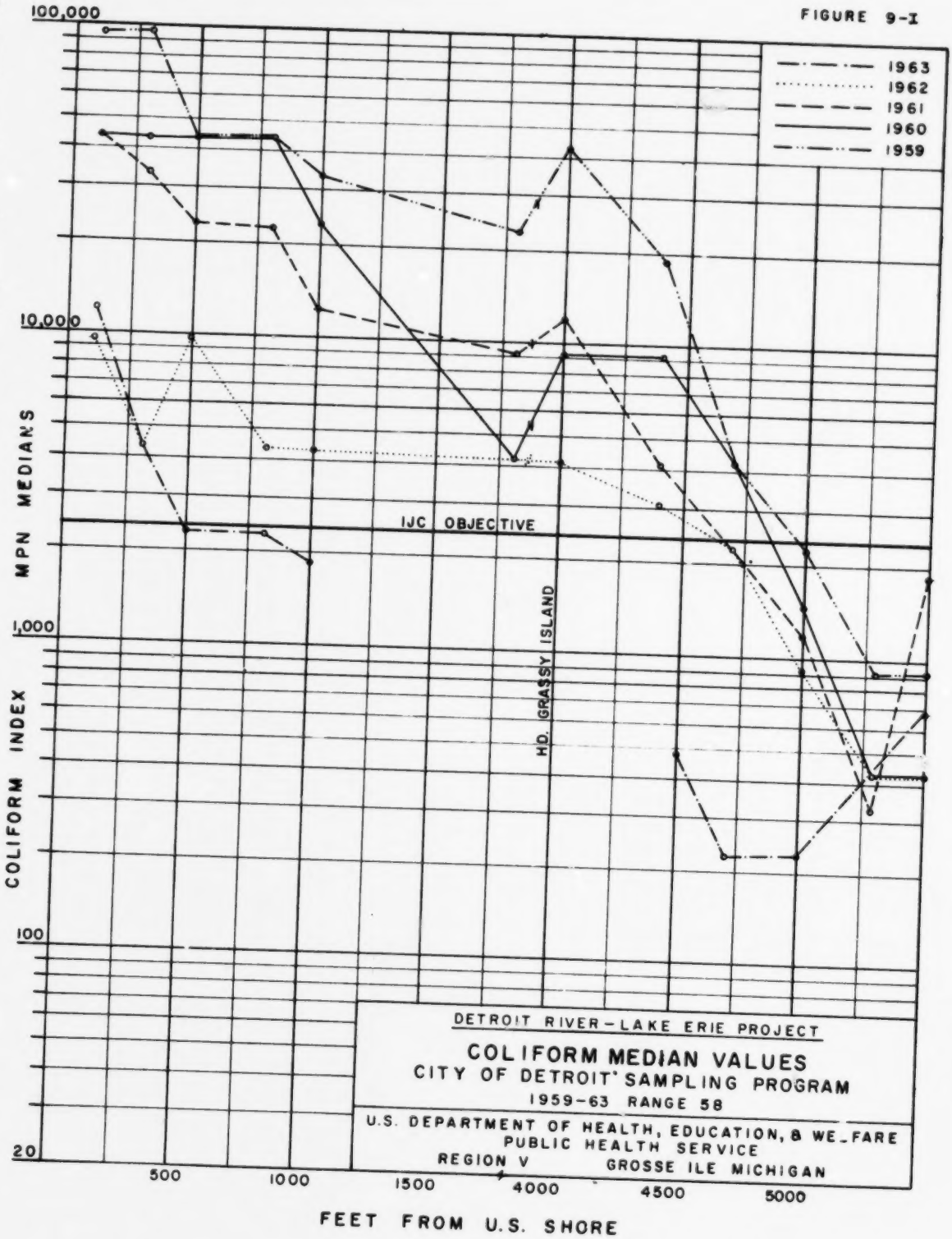

100,000
10,000
1,000
100
20
COLIFORM INDEX MPN MEDIANS
1963
1962
1961
1960
1959
IJC OBJECTIVE
HD. GRASSY ISLAND
500
1000
1500
4000
4500
5000
FEET FROM U.S. SHORE
DETROIT RIVER-LAKE ERIE PROJECT
COLIFORM MEDIAN VALUES
CITY OF DETROIT SAMPLING PROGRAM
1959-63 RANGE 58
U.S. DEPARTMENT OF HEALTH, EDUCATION, & WELFARE
PUBLIC HEALTH SERVICE
REGION V
GROSSE ILE MICHIGAN

FIGURE 10-I

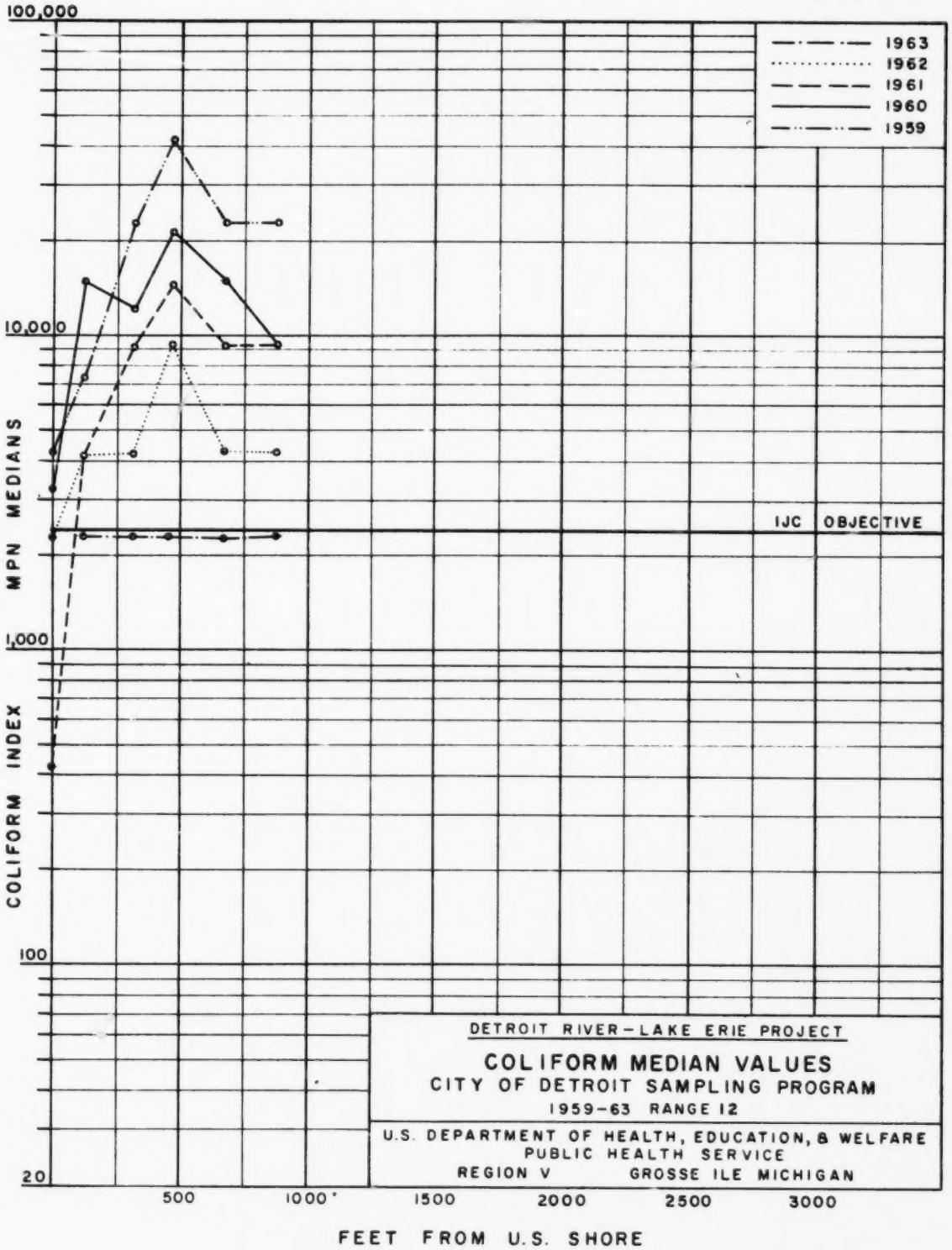
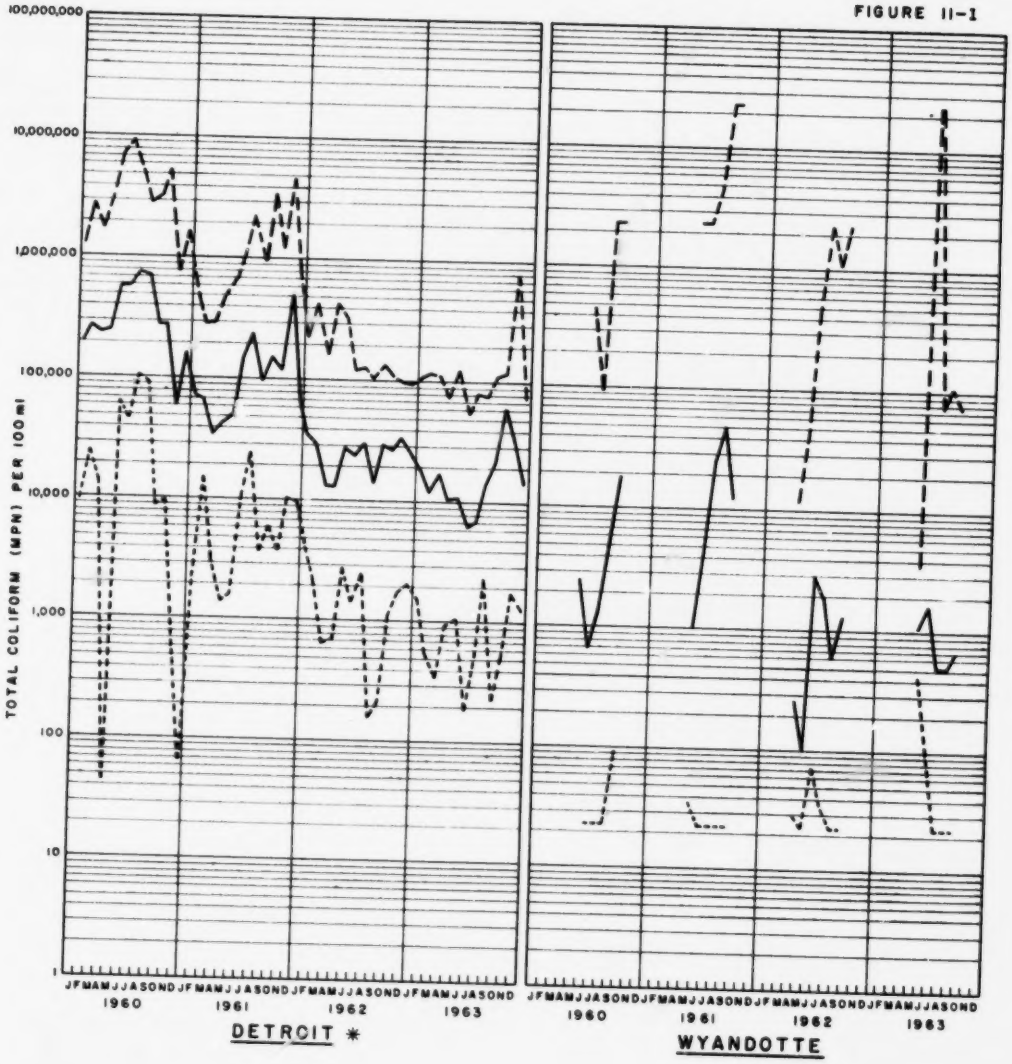

100,000
10,000
1,000
100
20
COLIFORM INDEX MPN MEDIANS
1963
1962
1961
1960
1959
IJC OBJECTIVE
500
1000
1500
2000
2500
3000
FEET FROM U.S. SHORE
DETROIT RIVER-LAKE ERIE PROJECT
COLIFORM MEDIAN VALUES
CITY OF DETROIT SAMPLING PROGRAM
1959-63 RANGE 12
U.S. DEPARTMENT OF HEALTH, EDUCATION, & WELFARE
PUBLIC HEALTH SERVICE
REGION V GROSSE ILE MICHIGAN

FIGURE II-1



LEGEND

——— Monthly Geometric Mean

— — — Maximum Monthly Value *

- - - - - - Minimum Monthly Value *

* Maximum & Minimum Daily Geometric Mean During The Month At Detroit

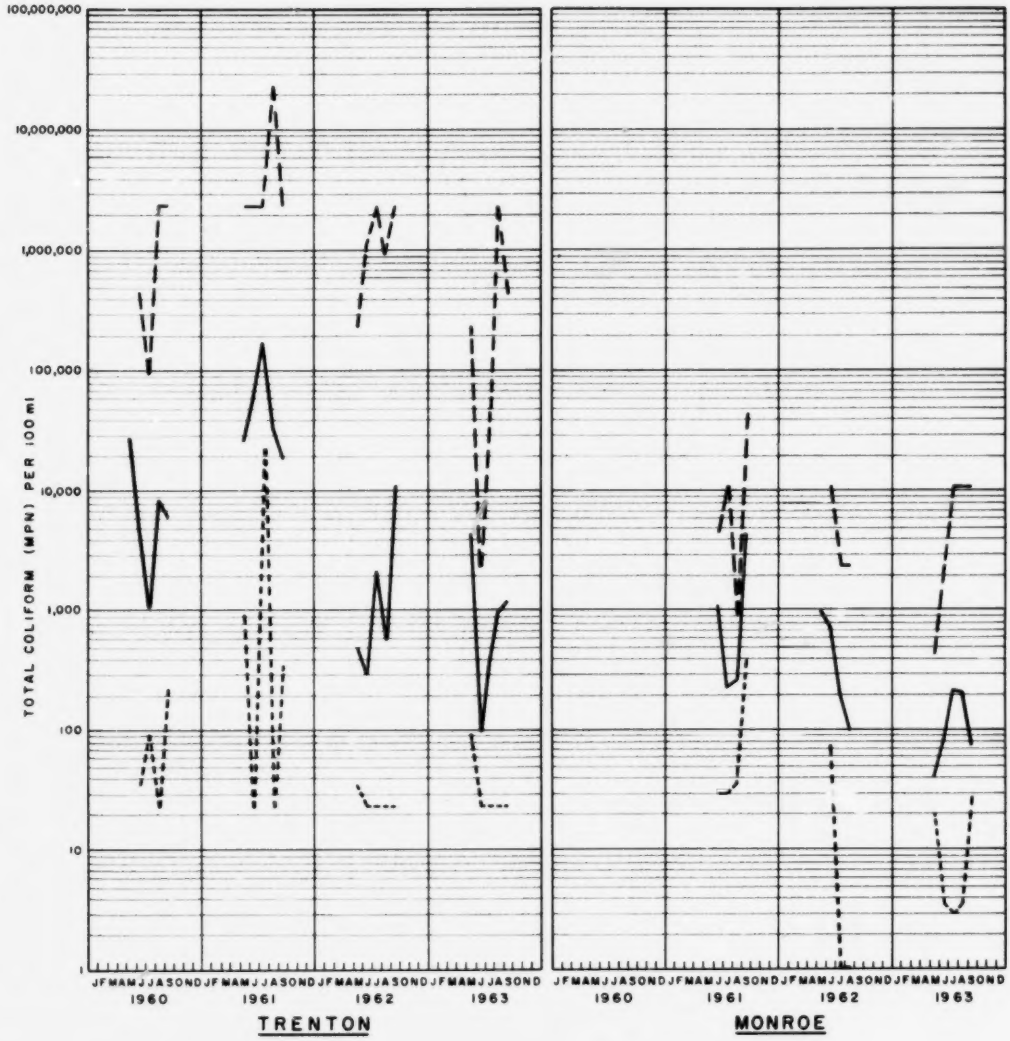
DETROIT RIVER–LAKE ERIE PROJECT

COLIFORM CONCENTRATIONS IN EFFLUENT

SEWAGE TREATMENT PLANT RECORDS

U.S. DEPARTMENT OF HEALTH, EDUCATION, & WELFARE
PUBLIC HEALTH SERVICE
REGION V GROSSE ILE, MICHIGAN

FIGURE II-I (Cont'd.)



LEGEND
Monthly Geometric Mean
Maximum Monthly Value
Minimum Monthly Value

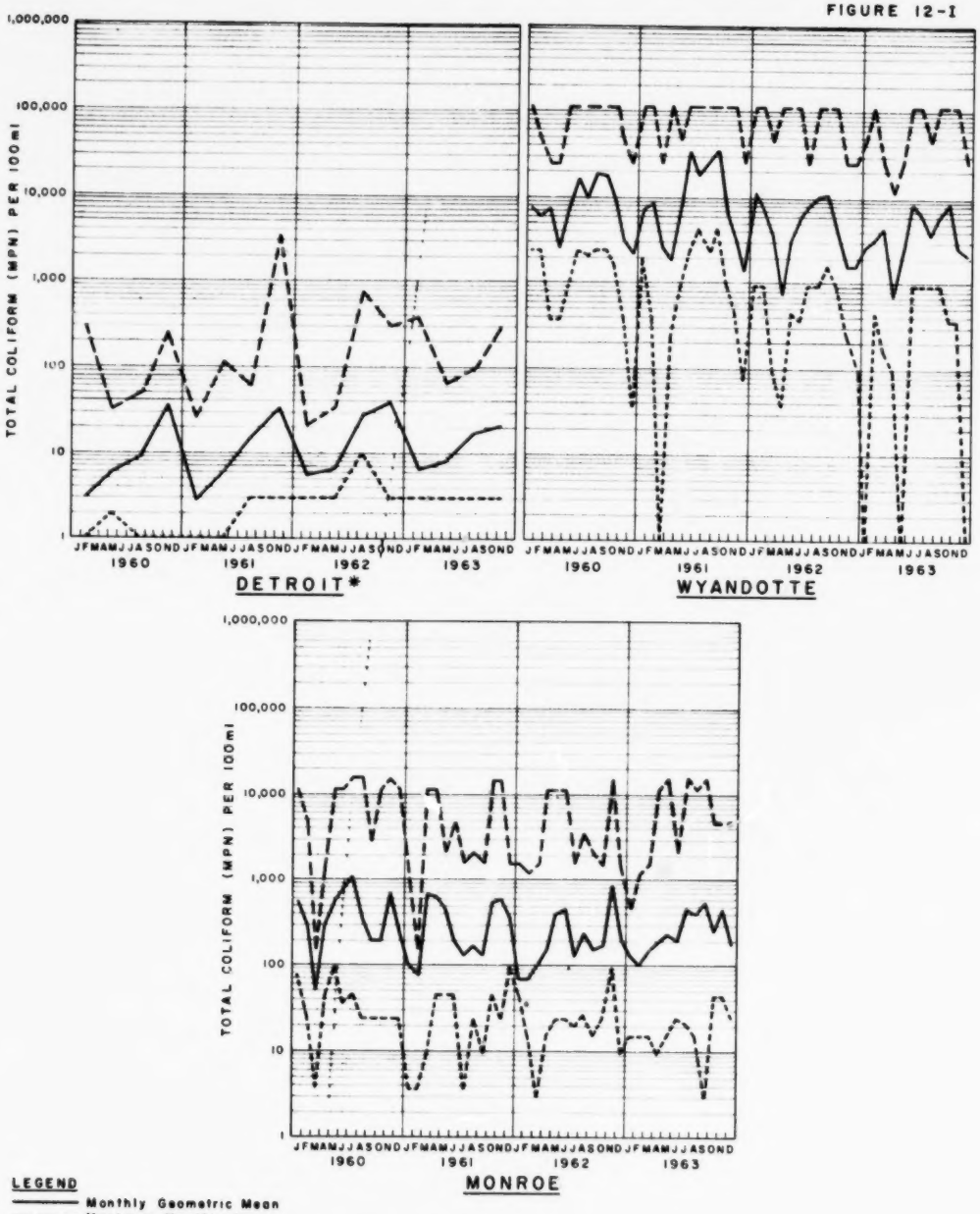
DETROIT RIVER–LAKE ERIE PROJECT

COLIFORM CONCENTRATIONS IN EFFLUENT

SEWAGE TREATMENT PLANT RECORDS

U.S. DEPARTMENT OF HEALTH, EDUCATION, & WELFARE
PUBLIC HEALTH SERVICE
REGION V GROSSE ILE, MICHIGAN

FIGURE 12-I



LEGEND

——— Monthly Geometric Mean

— — — Maximum Monthly Value

------- Minimum Monthly Value

* Results of Public Health Service Water Pollution Surveillance System at Intake. (Tri-monthly)

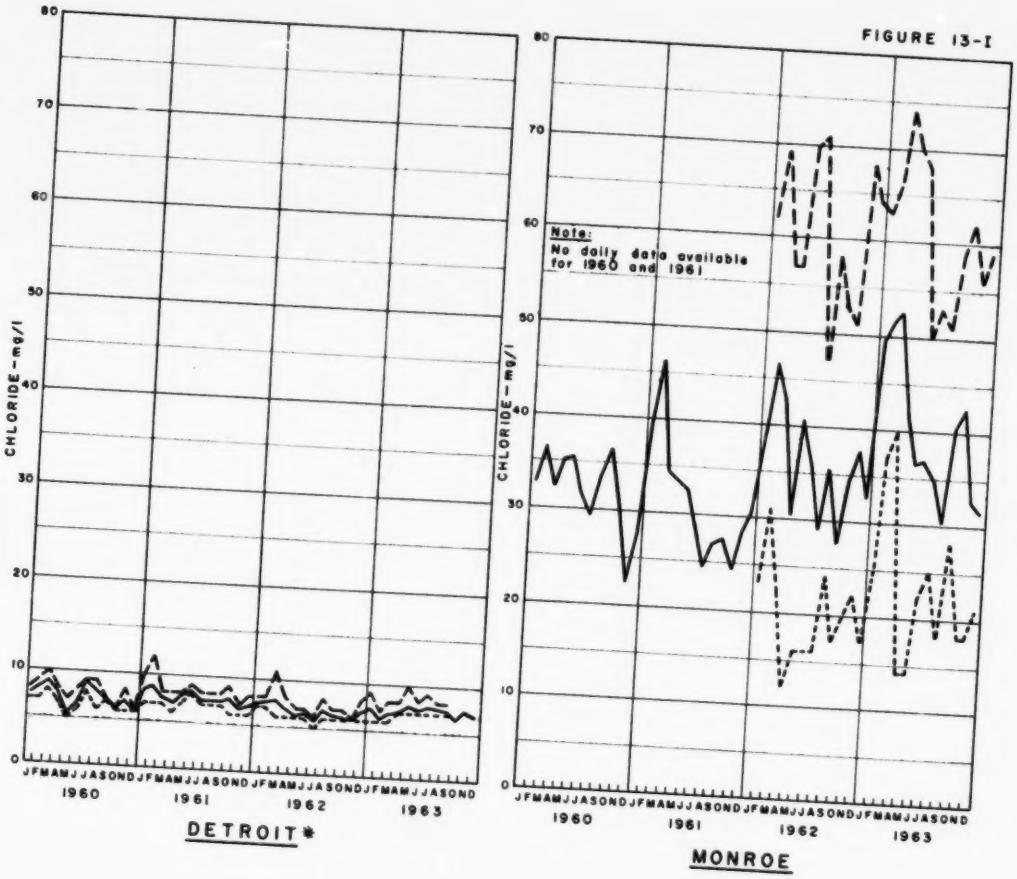
DETROIT RIVER–LAKE ERIE PROJECT

COLIFORM CONCENTRATIONS AT INTAKE

WATER TREATMENT PLANT RECORDS

U.S. DEPARTMENT OF HEALTH, EDUCATION, & WELFARE
PUBLIC HEALTH SERVICE
REGION V GROSSE ILE, MICHIGAN

FIGURE 13-I



LEGEND

Monthly Mean

Maximum Monthly Value

Minimum Monthly Value

* Results of Public Health Service Water Pollution Surveillance System at Intake.

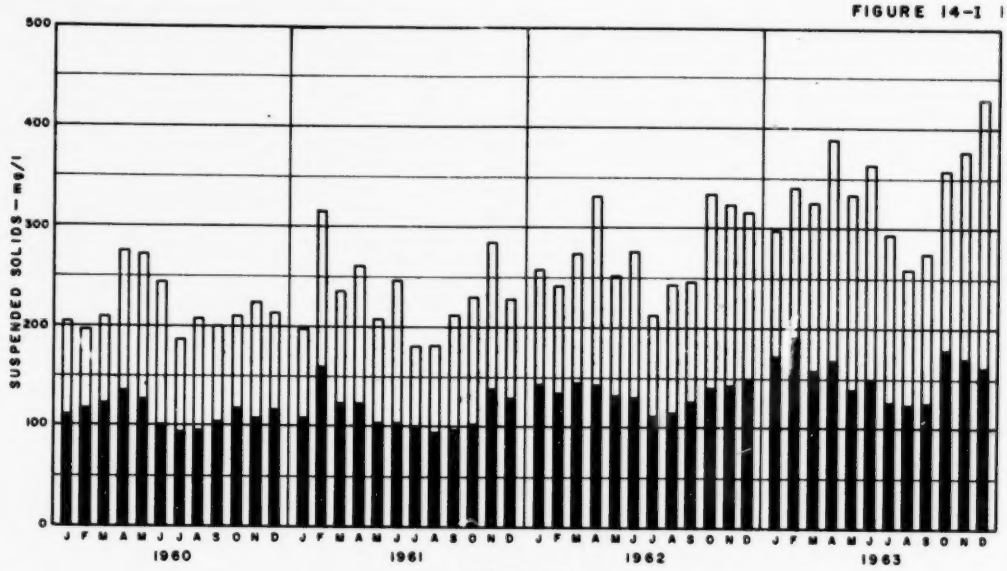
DETROIT RIVER-LAKE ERIE PROJECT

CHLORIDE CONCENTRATIONS AT INTAKE

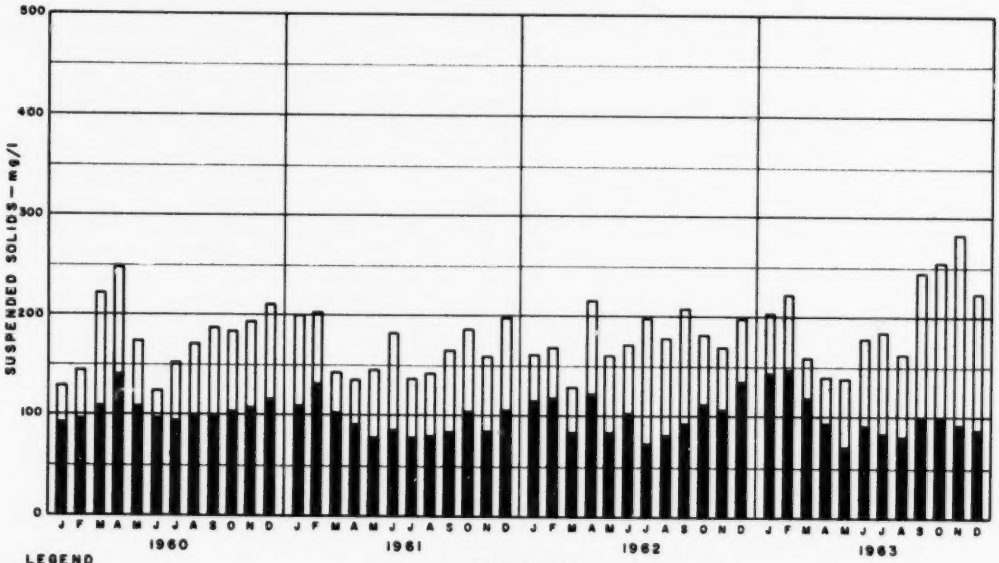
WATER TREATMENT PLANT RECORDS

U.S. DEPARTMENT OF HEALTH, EDUCATION, & WELFARE
PUBLIC HEALTH SERVICE
REGION V GROSSE ILE, MICHIGAN

FIGURE 14-I 1



DETROIT



WYANDOTTE

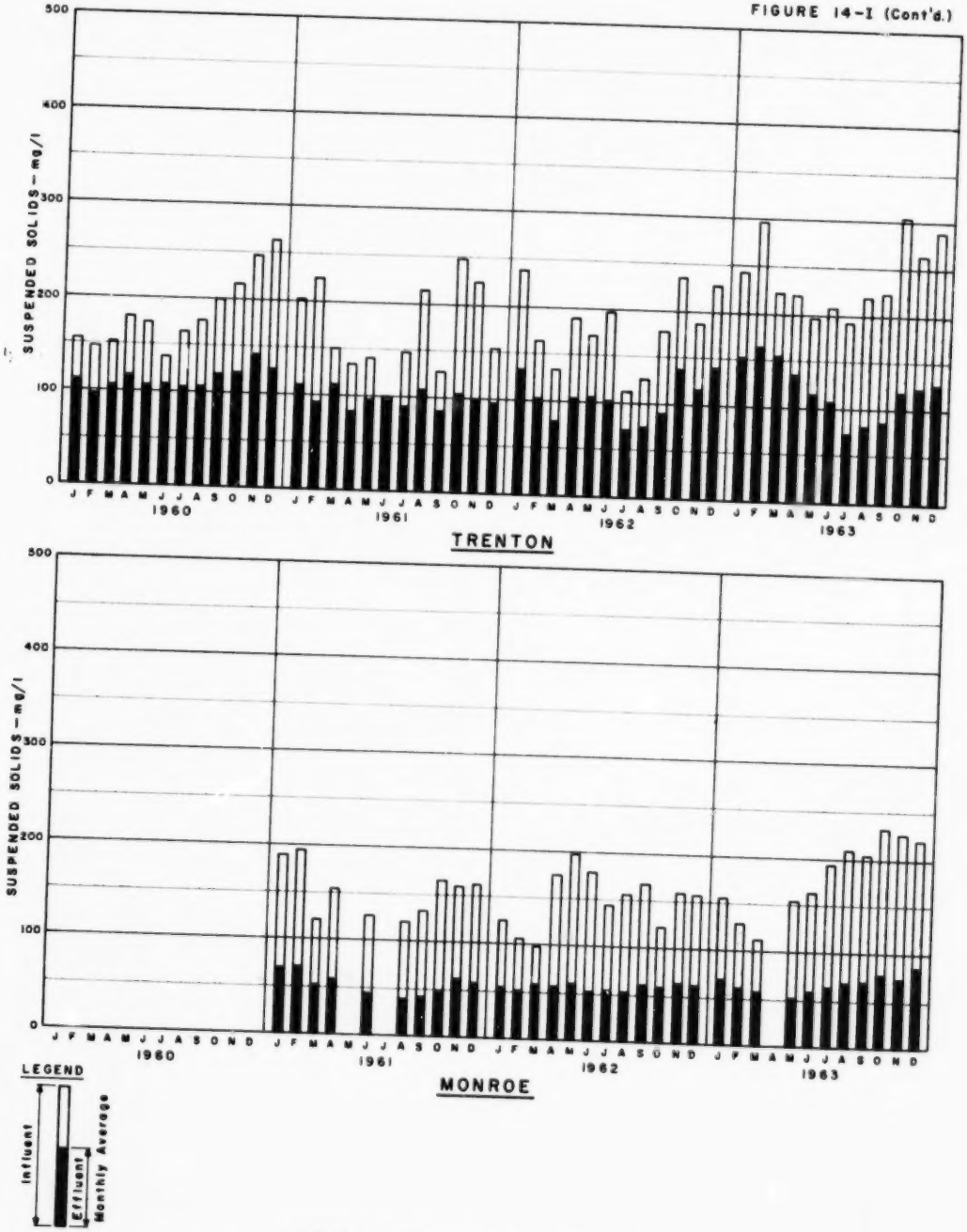
DETROIT RIVER--LAKE ERIE PROJECT

SUSPENDED SOLIDS IN EFFLUENT & INFLUENT

SEWAGE TREATMENT PLANT RECORDS

U.S. DEPARTMENT OF HEALTH, EDUCATION, & WELFARE
PUBLIC HEALTH SERVICE
REGION V GROSSE ILE, MICHIGAN

FIGURE 14-I (Cont'd.)



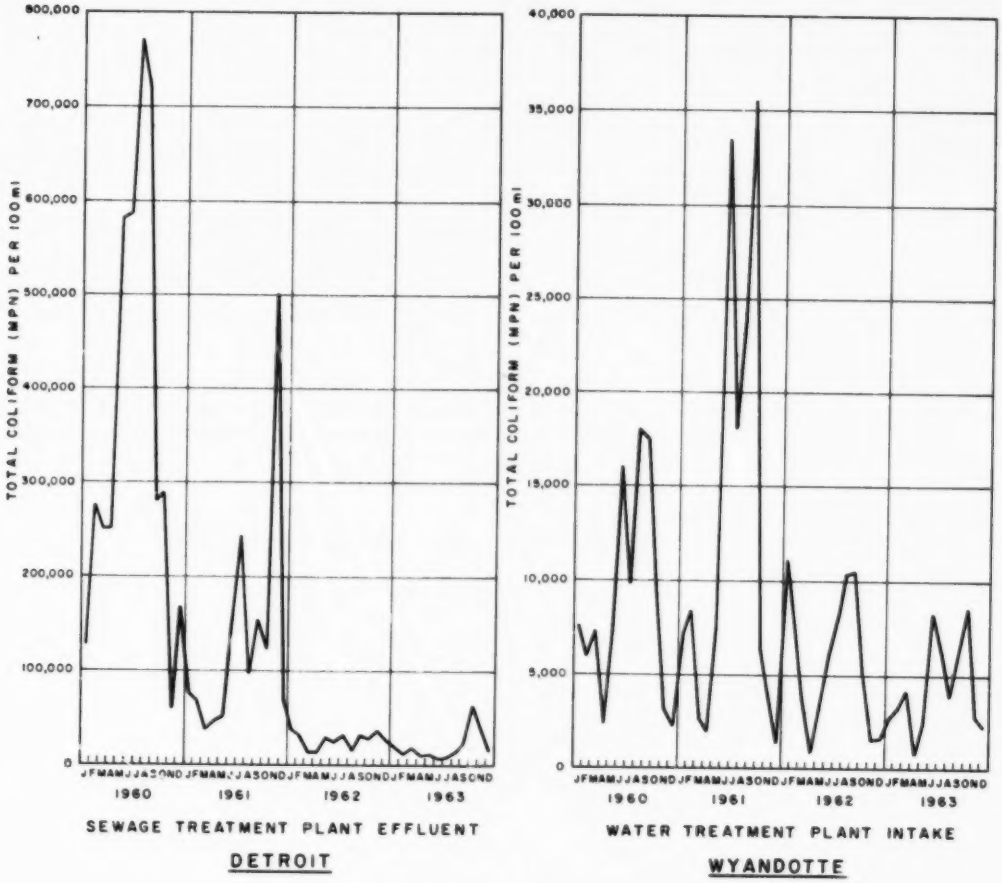
DETROIT RIVER—LAKE ERIE PROJECT

SUSPENDED SOLIDS IN EFFLUENT & INFLUENT

SEWAGE TREATMENT PLANT RECORDS

U.S. DEPARTMENT OF HEALTH, EDUCATION, & WELFARE
PUBLIC HEALTH SERVICE
REGION V GROSSE ILE, MICHIGAN

FIGURE 15-I



DETROIT RIVER—LAKE ERIE PROJECT

MONTHLY GEOMETRIC MEAN COLIFORM CONCENTRATIONS

SEWAGE & WATER TREATMENT PLANT RECORDS

U.S. DEPARTMENT OF HEALTH, EDUCATION, & WELFARE
PUBLIC HEALTH SERVICE
REGION V GROSSE ILE, MICHIGAN

Since plotting values on semi-logarithmic paper may tend to mask trends because of a compressed scale, the monthly geometric mean coliform densities were plotted in Figure 15-I for the effluent of the Detroit Sewage Treatment Plant and the Wyandotte Water Treatment Plant. This presentation more markedly demonstrates the reduction in total coliform densities at these two locations during the years 1962 and 1963.

Description of Area

The Detroit River, outstanding among great waterways of the world, performs a number of important functions for the area. It provides a shipping channel for the heavy Great Lakes traffic between Lake Erie and Lake Huron. In fact, the tonnage transported through the Detroit River is greater than that past any other port in the world. The River provides vast quantities of water for municipal and industrial purposes on both sides of the River. It receives large volumes of untreated and partially treated sewage and industrial wastes. Finally, the River provides, potentially, excellent opportunities for recreation.

Due to its location in the heart of the Great Lakes drainage basin, the Detroit area has developed into one of the most important industrial centers in the entire United States and the world's center of the automobile industry. It has a four-county area of approximately 2,040 square miles and, according to the 1960 census, a population of 3,863,480. Table 11-I breaks down the population figure by cities.

TABLE 3-I. POPULATIONS OF MAJOR CITIES

Macomb County		Monroe County	
East Detroit	45,756	Monroe	22,968
Mount Clemens	21,016		
Roseville	50,195		
St. Clair Shores	75,657		
Warren	89,246		

Oakland County		Wayne County	
Berkley	23,275	Allen Park	37,052
Birmingham	25,525	Dearborn	112,007
Ferndale	31,347	Detroit	1,670,144
Hazel Park	25,631	Ecorse	17,328
Madison Heights	33,343	Garden City	38,017
Oak Park	36,632	Grosse Pointe Park	15,457
Pontiac	82,233	Grosse Pointe Woods	18,580
Royal Oak	80,612	Hamtramck	34,137
Troy	19,058	Highland Park	38,063
		Inkster	39,097
		Lincoln Park	53,933
		Livonia	66,702
		River Rouge	18,147
		Southgate	29,404
		Trenton	18,439
		Wayne	19,071
		Wyandotte	43,519

Climate

Detroit is situated centrally in the Great Lakes region and is under the climatic influence of these large bodies of water. Because of the stabilizing influence of the Great

Lakes, extreme temperatures occur rather infrequently in the Detroit area. Records from the U.S. Weather Bureau station in Detroit indicate that temperatures of 100°F or more occur about once in every 4 years and sub-zero temperatures occur on only about 4 days each winter.

The growing season, which is defined as being the length of period between spring and fall frosts, has ranged from 122 days to 208 days, the average being 171 days.

The mean annual temperature at Detroit is about 49.1° F. The average annual precipitation at Detroit is 31.49 inches. (See Figure 16-I.) Variations in monthly precipitation and in snowfall are shown in the same figure. A little less than 25 per cent of this total precipitation runs off to the streams. Short and irregular periods of drought occur from time to time but long periods of drought are rare. Winters are marked by cloudiness and frequent snow flurries. Summers have plentiful sunshine without extreme heat. Prevailing winds are from the southwest with winds from the northwest being next in frequency of occurrence. The average wind velocity is about 10 miles per hour. Figure 17-I presents the climatological data on per cent of sunshine, maximum and mean wind velocity, relative humidity, and temperature.

Geology

The bedrock of this area consists mainly of sedimentary rocks laid down during the Devonian Period of the Paleozoic Era. These sedimentary rocks are principally limestones, shales, and sandstones, with some conglomerates. The thickness of the beds varies from 200 to 1,700 feet. A glacial and postglacial drift mantle overlies these rock beds throughout the area. It varies in thickness up to 600 feet and is responsible for much of the smoothness of the ground surface of the region. While the surface in general is smooth or broadly rolling, it is broken here and there by low morainic accumulations and by beach ridges of former lakes.

Extensive beds of rock salt underlie the entire area. In the lower reaches of the Detroit River and in the western end of Lake Erie, the depth of cover over the salt beds is approximately 1,000 feet; in the upper reaches the depth of cover increases to about 2,000 feet. Throughout the area the beds are stratified by dolomitic sediment and shale.

Groundwater

Groundwater occurs through the area, but that available locally is usually of high mineral content and uncertain quantity. It is principally a calcium and magnesium bicarbonate water, with varying amounts of iron and sulfate and, often, hydrogen sulfide.

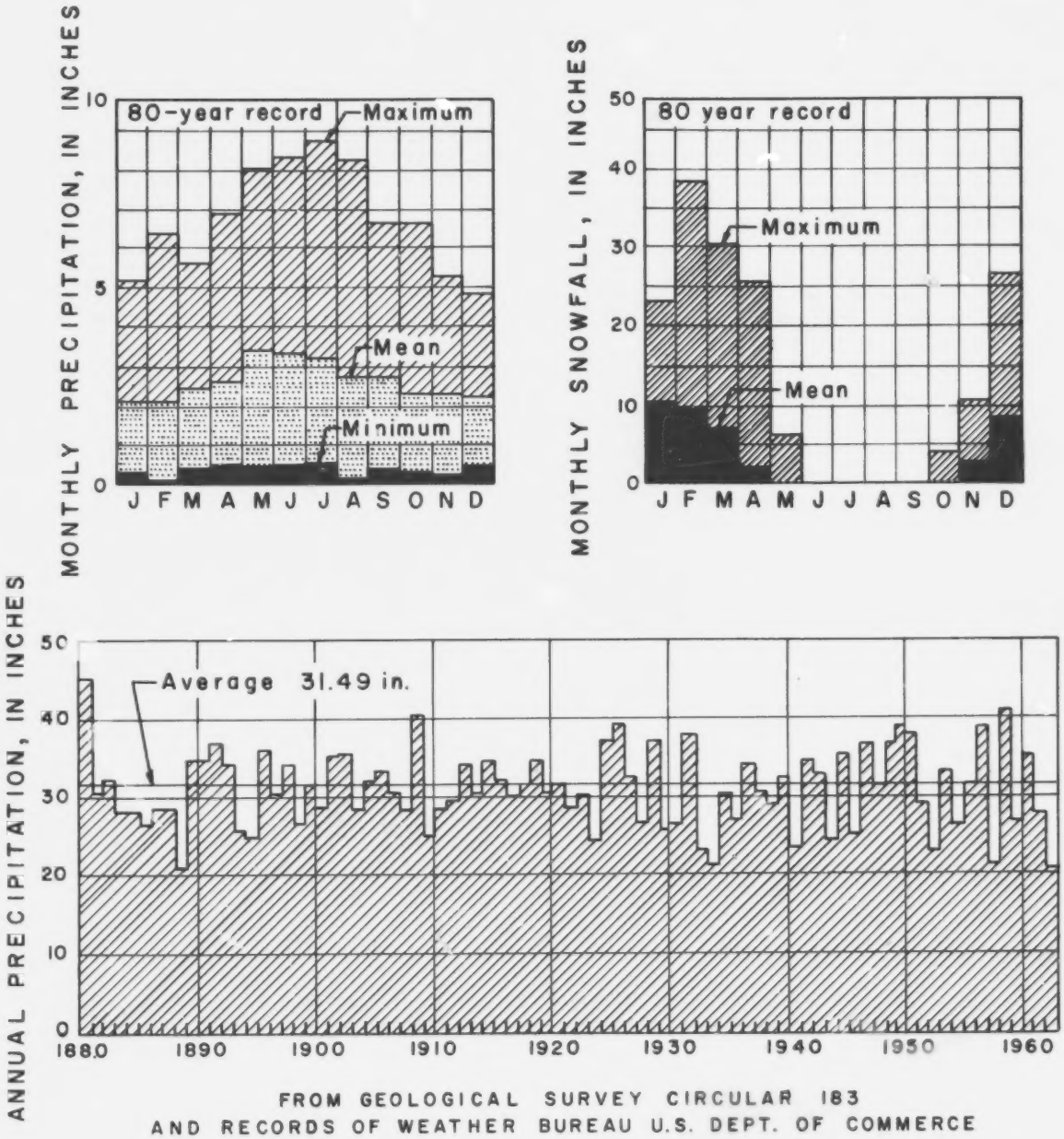
Land Use and Development

The area serves three important economic functions: agriculture, industry, and recreation. The land bordering the western edge of Lake Erie is in general used for farming and recreation while that in the Detroit area is used for industrial purposes.

The inland area in the western Lake Erie basin is mostly used for farming, chiefly divided into small individually owned farms growing field crops, vegetables, sod grass, and fruits. There is also extensive dairy and poultry farming. The forests have been cut down and there remain only small, isolated woodlots which have little or no effect upon the flow or quality of the streams.

The automobile industry has been responsible for rapid industrial growth in the Detroit area during the past 30 to 40 years. This industry has brought many related activities such as steel mills, blast furnaces, tool and die manufacturing, and coke plants.

FIGURE 16-I



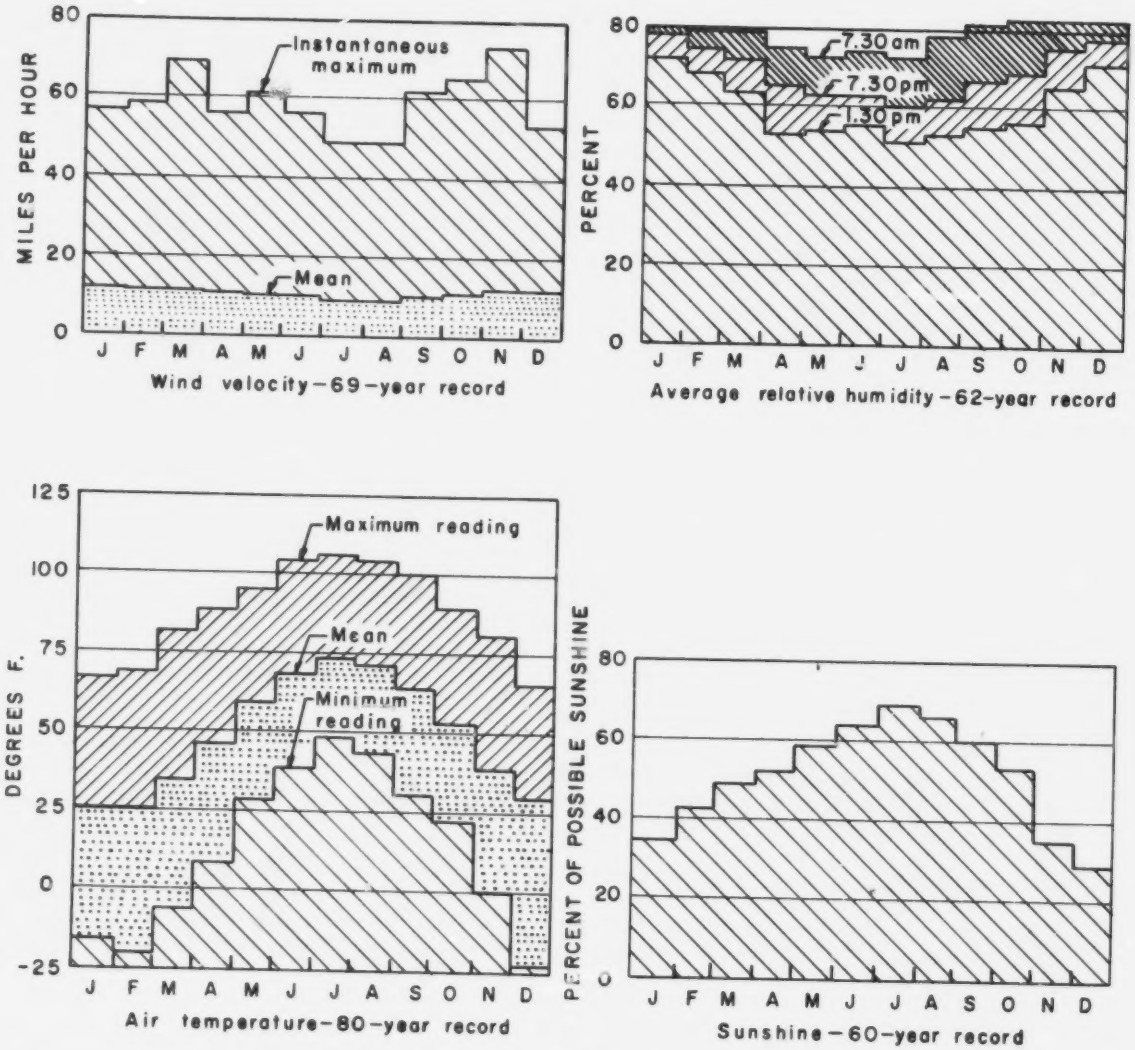
FROM GEOLOGICAL SURVEY CIRCULAR 183
AND RECORDS OF WEATHER BUREAU U.S. DEPT. OF COMMERCE

DETROIT RIVER-LAKE ERIE PROJECT

PRECIPITATION AT DETROIT

U.S. DEPARTMENT OF HEALTH, EDUCATION, & WELFARE
PUBLIC HEALTH SERVICE
REGION V GROSSE ILE, MICHIGAN

FIGURE 17-I



FROM GEOLOGICAL SURVEY CIRCULAR 183

DETROIT RIVER-LAKE ERIE PROJECT

CLIMATOLOGICAL DATA FOR DETROIT

U.S. DEPARTMENT OF HEALTH, EDUCATION, & WELFARE
PUBLIC HEALTH SERVICE
REGION V GROSSE ILE, MICHIGAN

Other industries include chemical plants, pulp and paper mills, oil refineries, and the manufacture of rubber and related products.

Extensive use has been made of the many islands for industrial and recreational purposes. Zug Island, Fighting Island, and the upper end of Grosse Ile are being used for the disposal of waste materials resulting from the manufacture of caustic soda and soda ash. Grassy Island and Mud Island are being used for the disposal of material from dredging operations; Belle Isle and Bois Blanc Island are devoted to recreational purposes.

Summer residences and cottages dot the western shoreline of Lake Erie. Public bathing beaches are noted in the Detroit River at Belle Isle and in western Lake Erie at Sterling State Park. Pointe Mouillee is an important wildlife habitat along with other reaches of the waterway which serve as overwintering locations for migrating birds.

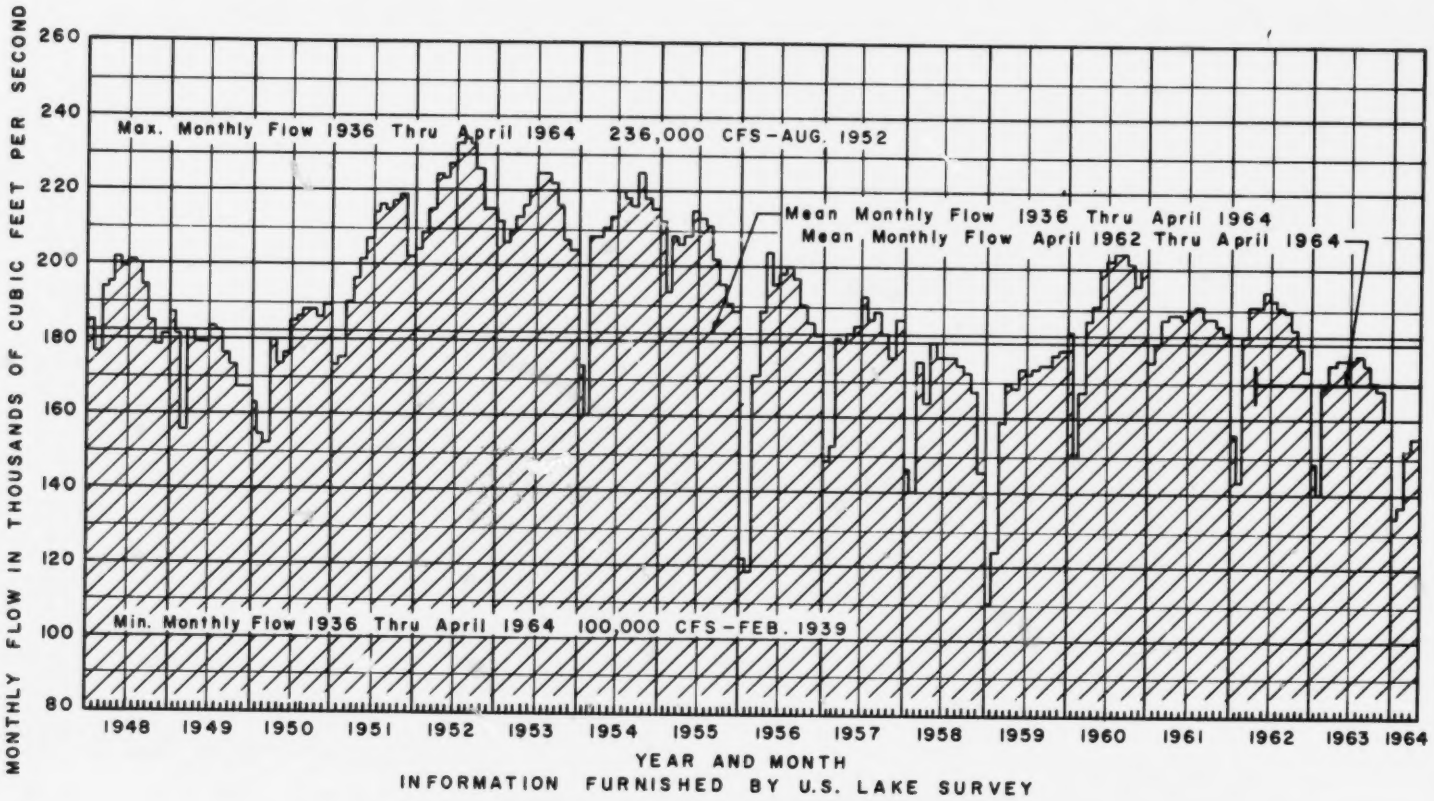
Bodies of Water Under Study

A. DETROIT RIVER. The Detroit River is the outlet for Lake St. Clair. It begins at Windmill Point and flows in a southwesterly and then southerly direction for about 31 miles to its mouth at Lake Erie. The normal drop in water level between Lake St. Clair and Lake Erie is 2.8 feet. The River, considering just its own drainage area, drains an area of 1,786 square miles in the United States. The upper 13 miles of the stream has an unbroken cross-section with an average width of 2,400 feet, except at its head where it is divided by Peach Island and Belle Isle. The stream bed in this upper reach consists of clay. Mean depth in this upper reach is approximately 25 feet; the maximum depth reaches 52 feet. The lower portion broadens out and is characterized by many islands and shallow expanses. The two largest islands are Fighting Island and Grosse Ile. There are several smaller islands, and the waters are spotted with large areas of marshland. In the lower River underlying rock is exposed and the shipping channels have been cut through it to a depth of 28 feet.

The flow of the Detroit River is exceptionally steady. Because of the tremendous storage provided by Lakes Superior, Huron, and Michigan, it is exceeded in this respect by few, if any, rivers in the world. A monthly hydrograph of the Detroit River since 1948 is shown in Figure 18-I.

The average discharge of the Detroit River for the period 1936 through April 1964 was 182,000 cfs. The monthly averages ranged from 100,000 cfs to 236,000 cfs. These extremes were probably affected by winds, ice, or sudden change in barometric pressure. From April 1962 through April 1964 the flow averaged 170,000 cfs.

In general, the higher the stage of a river, the greater its flow. However, because of the small differences in level between Lake St. Clair and Lake Erie, the relationship between stage and discharge for this River is not easily determined. It is affected by several factors: first, by dredging operations that are carried on for the improvement of navigation through certain reaches in the River; second, by differences in level between Lake Erie and Lake St. Clair caused by varying rates of inflow from the respective drainage areas; and third, the most pronounced, by winds or changes in barometric pressure usually occurring over a part of Lake Erie and causing abnormally high or low elevations of water at the outlet of the Detroit River. When the effect of this third factor occurs, the water may pile up at the western end of Lake Erie to an elevation above that of Lake St. Clair and, as a result, the flow of the Detroit River may actually reverse its direction. This is an extremely rare occurrence but, according to the U.S. Lake Survey (Table 4-I), has occurred twelve times since 1911 with the last occurrence in January 1948. By a reverse mechanism the water level at the lower end of the River may suddenly drop, causing a great increase in discharge for a given stage. As an illustration, on January 31, 1914, the elevation of the water at the mouth of the river dropped more than 6 feet in 10 hours. This phenomenon resulted from a severe storm over Lake Erie.



INFORMATION FURNISHED BY U.S. LAKE SURVEY

DETROIT RIVER-LAKE ERIE PROJECT

HYDROGRAPH OF MONTHLY MEAN FLOWS DETROIT RIVER AT DETROIT, MICH.

JANUARY 1948 THROUGH APRIL 1964

U.S. DEPARTMENT OF HEALTH, EDUCATION, & WELFARE
PUBLIC HEALTH SERVICE
REGION V GROSSE ILE, MICHIGAN

FIGURE 18-I

770-026 O-63-4

TABLE 4-I. GRADIENT REVERSALS IN DETROIT RIVER

DATA FROM U.S. LAKE SURVEY

Date	Lake St. Clair Gaging Station	Lake Erie Gaging Station	Maximum Difference in Elevation Between Lake Erie and: Ft. Wayne	Maximum Difference in Elevation Between Lake Erie and: Lake St. Clair	Time in Hours Elevation of Lake Erie Exceeded: Ft. Wayne	Time in Hours Elevation of Lake Erie Exceeded: Lake St. Clair
Feb. 5-6, 1911	Windmill Pt.	Amherstburg	0.35	0.62	6	7.5
Jan. 30-31, 1914	Windmill Pt.	Amherstburg	0.35	0.8	5	4.5
Dec. 29-30, 1915	Windmill Pt.	Amherstburg	0.5	0.86	4.5	5
Apr. 10-11, 1918	Windmill Pt.	Amherstburg	0.15	0.45	2	6
			0.15	0.55	4.5	7
Sept. 4-5, 1918	Windmill Pt.	Amherstburg	0.4	0	2.5	0
Feb. 19-20, 1927	Windmill Pt.	Amherstburg	0.1	0.2	2	4
Mar. 8-9, 1928	Windmill Pt.	Amherstburg	0.2	0.2	3	3
Mar. 21-22, 1932	Grosse Pt. Yacht Club	Amherstburg	0.1	0.4	1	7.5
			0.3		1.5	
Jan. 29-30, 1939	Grosse Pt. Yacht Club	Gibraltar	0.9	1.45	8.5	7
Feb. 9-10, 1939	Grosse Pt. Yacht Club	Gibraltar	0.9	1.55	12.5	14.5
Mar. 4-5, 1944	Grosse Pt. Yacht Club	Gibraltar	--	0	--	0
Jan. 1-2, 1948	Grosse Pt. Yacht Club	Gibraltar	--	0.65	--	4

B. ROUGE RIVER. The Rouge River, a tributary to the Detroit River, rises northwest of Detroit and flows southeasterly, emptying into the Detroit River near Ecorse. It has two tributaries, the Middle and Lower branches, and drains an area of about 467 square miles. Its basin lies almost entirely in an old lake bed and as a result, except for perhaps the upper fringe, it is relatively flat and impervious and has practically no natural surface storage. The main stream is approximately 32 miles long and falls about 360 feet from its headwaters to the mouth. The lower 3.5 miles, through the Short-Cut Canal, consists of a dredged channel for use of vessel traffic serving the industries in the area. Controlling depths approximate 21 feet for a middle channel width of 200 feet. The Short-Cut Canal is an artificial connection, 3,000 feet long, from the Detroit River to a bend in the Rouge River which eliminates an "S' shaped curve near the mouth.

Discharge measurements are taken by the U.S. Geological Survey at the Rouge River, the Middle Rouge and the Lower Rouge. The summation of the average discharges of record from these three gages shows an average flow of the Rouge River above the influence from Detroit River backwater of approximately 235 cfs.

Two small tributaries, Ecorse River and Monguagon Creek, enter the Detroit River below the Rouge River. Their contribution of flow is insignificant when compared to that of the Detroit River.

C. HURON RIVER. The Huron River rises west of Detroit and flows in a southwesterly direction, emptying into the Detroit River just above Pointe Mouillee. Its drainage basin has the shape of a mallet with the handle providing the outlet. The river is about 80 miles long and falls about 440 feet in its descent to the Detroit River. The major part of its drainage reaches the main stem above Ann Arbor and from this point downstream receives no important tributaries. Most of the upper portion is hilly and contains many lakes which provide much natural storage. The drainage area is 890 square miles.

The closest gaging station to the mouth where reliable records are kept by the U.S. Geological Survey is at Ann Arbor. Here the average discharge of record is 445 cfs and the drainage area is 711 square miles. This gage does not indicate the total or daily contribution of water to the Detroit River because: (1) eight impounded lakes between the gaging station and the mouth provide considerable storage which smooths out the stream fluctuations, and (2) it does not take into account approximately 179 square miles of drainage area.

D. MICHIGAN WATERS OF LAKE ERIE. The western end of Lake Erie is characterized by shallow water, with maximum depths of 29 feet. For several miles from the Michigan shore, the water is generally less than 25 feet deep, and near the Detroit River outlet, depths in excess of 20 feet are rare. This ship channel is dredged through the shallow water to a depth of 28.5 feet. Lake Erie is subject to hard winds from both the east and west, and from time to time barometric seiches occur. The effect of changing winds and seiches is to raise and lower the lake level at the western end near Monroe, and to create marked variations from normal water movements and currents. The only significant tributary to Michigan Lake Erie besides the Detroit River is the Raisin River. Minor tributaries include the creeks named Swan, Stony, and Sandy north of the Raisin River, and those called Plum, LaPlaisance, and Otter south of the Raisin River. Table 13-I gives descriptive measurements of the Michigan waters of Lake Erie.

TABLE 5-I. CHARACTERISTICS OF MICHIGAN LAKE ERIE

Mean Depth	14.3 feet
Maximum Depth	29 feet
Surface Area	105 square miles
Volume	960,960 acre - feet
Drainage Area[1]	1,525 square miles

[1]Excluding the Detroit River and the Lake surface area.

E. RAISIN RIVER. The Raisin River, entering the lake at Monroe, drains an area of 1,125 square miles. It rises approximately 50 miles due west of Monroe and for 20 miles flows in an easterly direction. For the next 30 miles it flows southerly before taking a sharp turn to flow in a northeasterly direction for 20 miles. The final 15 miles of the River, flowing in an easterly direction, receive no important tributaries. The shape of the basin is very similar to that of its neighbor, the Huron River. The average discharge of record measured near Monroe is 714 cfs.

Five low-head dams are spaced at approximately 1-mile intervals near the mouth of the River.

The last 1.5 miles of the River contain a dredged navigation channel serving the Port of Monroe with controlling depths of 21 feet and a middle channel width of 200 feet. Lake-affected backwater extends approximately 3 miles up the River to the first low head dam. The improved channel, widened to 300 feet, extends 3 miles into Lake Erie.

F. LAKES. Numerous inland lakes are located in the headwater reaches of the tributary streams in the Detroit area. All of them are in headwater areas and are fed by small drainage areas. These lakes, unlike many small lakes elsewhere, do not provide much recharge to groundwater supplies and thus the rate of water supply that can be continuously obtained from lakes in this area is generally limited to their outflow rates which are relatively small.

SECTION II

WATER USE INVENTORY

INTRODUCTION

In an area as diversified and complex as the study area of the Detroit River-Lake Erie Project, all water uses must be considered in order to arrive at the best plan for maximum potential use of the waters.

This report contains a summary of the many and varied water uses in the study area.

Water uses have been divided into the following categories: commercial shipping, dredging operations, fish and wildlife, recreational uses, municipal and industrial water supply, industrial and domestic waste disposal, and combined sewer overflows. No one use is presented as more important than another.

COMMERCIAL SHIPPING

Because of a strategic geographical location, the Detroit River has become an important artery of commercial shipping between the upper and lower Great Lakes. Millions of tons of iron ore from the Minnesota ranges pass through the river on their way to the steel mills of Cleveland and Pittsburgh. Coal is transported up the river from the Appalachian fields to the industries along Lakes Michigan and Superior. The opening of the St. Lawrence Seaway has also contributed significantly to the traffic in the river. Tonnage shipped through the Detroit River is so great that during a recent eight-month season, 130,560,000 tons of total commerce were shipped through the river. This exceeds the entire combined tonnage shipped through the Panama and Suez Canals in one year.

Although records for the 1963 shipping season are not yet available, the shipping information for the 1961 and 1962 seasons is presented in Table 1-II. All of the following information is taken from the U.S. Army Corps of Engineers publication entitled, "Waterborne Commerce of the United States, Calendar Year 1961 and 1962." All records include Port of Detroit traffic and Windsor-Detroit traffic. This data therefore includes barge, ferry, and tugboat traffic. An explanation of the terminology follows the tables.

Over 150 different types of cargo were transported through the river during the 1961 and 1962 seasons. These varied from bulk products like iron ore to highly developed products such as steam turbines. The largest cargo to be shipped overseas was scrap iron and steel with 1,064,828 tons passing down the river during the year 1961. Rolled and finished steel mill products constituted the largest foreign import with 188,768 tons passing through the river or being unloaded in the Detroit port area during the 1962 season. In the domestic and U.S. Canadian trade categories, the largest downbound tonnage consisted of iron ore and concentrates with 34,986,741 tons of the material being recorded in 1962. The largest upbound cargo was bituminous coal and lignite, with 26,446,249 tons passing up the river during the 1962 season.

The ships traversing the river varied from tugboats and great lakes freighters to the latest ocean vessels. One downbound vessel had a maximum draft of 28 feet while 8,825 of the vessels over the two year period had a draft of 12 feet or less.

The passenger traffic figures show that the majority of the passenger traffic is confined to the Detroit area. The major contributors to the heavy local traffic are the Bob-Lo Excursion Company's pleasure boats, the S.S. St. Claire and S.S. Columbia, which run frequent excursion trips to Bois Blanc Island off the southern tip of Grosse Ile.

DREDGING OPERATIONS

The dredging operations in the Project's study area come under the jurisdiction of the U.S. Army Engineer District, Detroit, Corps of Engineers. These operations of the Corps are divided into the major categories of New Work and Maintenance Work. All of the work

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TABLE 1-II. WATERBORNE COMMERCE OF THE DETROIT RIVER

	1961	1962
TOTAL PASSAGES		
Upbound	10,891	10,191
Downbound	11,098	10,390
TONNAGE SUMMARIES		
Upbound	33,091,926 +	35,375,199
Downbound	63,090,136	64,663,909
Dept. of Defense Controlled and Special Cargo	3,933	-
Total	96,185,995	100,039,108
TONNAGE BREAKDOWN		
Overseas Imports (upbound)	669,341	773,065
Overseas Exports (downbound)	3,807,891	4,166,334
Canadian Imports (upbound)	1,128,032	2,149,157
Canadian Imports (downbound)	2,981,227	2,883,829
Canadian Exports (upbound)	4,267,650	3,707,134
Canadian Exports (downbound)	4,986,691	6,249,152
Coastwise Shipping (upbound)	75,650	119,941
Coastwise Shipping (downbound)	14,616	24,523
Lakewise Shipping (upbound)	26,865,236	28,510,856
Lakewise Shipping (downbound)	51,072,866	51,134,844
Internal Shipping (upbound)	33,856	55,791
Internal Shipping (downbound)	73,927	171,952
Local (upbound)	52,161	59,255
Local (downbound)	152,918	33,275
PASSENGER TRAFFIC		
Upbound	528,392	557,910
Downbound	523,834	562,005
Local Traffic	1,051,065	1,119,319
Through Traffic	1,161	596
Total	1,052,226	1,119,915

+ Tonnage figures for the Detroit River, as given by the Corps of Engineers, do not include Canadian-Canadian or Canadian-Foreign trade. Figures for this type of trade are kept at Sault Ste. Marie, and in 1961, 9,998,357 tons of such commerce are recorded at that point. A figure of 9,157,790 tons of eastbound commerce is recorded, and based on this, it is estimated that about 7,500,000 tons of this foreign commerce passes through the Detroit River unrecorded by the Corps of Engineers or by Canada.

TABLE 1-II (CONTINUED). WATERBORNE COMMERCE OF THE DETROIT RIVER

COMPARATIVE TRAFFIC

Year	Tons	Passengers
1962	100,039,108	1,119,915
1961	96,185,995	1,052,226
1960	111,165,158	1,092,975
1959	92,618,415	1,140,929
1958	87,878,763	979,021
1957	130,515,923	873,420
1956	124,849,617	1,078,452
1955	132,507,367	1,100,474

TRANSACTIONS OF PORTS ON THE DETROIT RIVER	1961	1962
U.S. Overseas Imports	171,131	233,486
U.S. Overseas Exports	526,087	303,109
U.S. Receipts of Canadian Shipments	1,587,045	2,478,221
U.S. Shipments to Canadian Ports	210,914	182,826
U.S. Coastwise Receipts	64,080	81,146
U.S. Coastwise Shipments	14,616	13,173
U.S. Lakewise Receipts	20,958,960	22,337,730
U.S. Lakewise Shipments	1,074,196	1,060,533
U.S. Internal Shipping Receipts	30,707	55,791
U.S. Internal Shipping Shipments	68,147	135,521

EXPLANATION OF TERMINOLOGY

Overseas Exports and Imports refers to tonnage shipped through the Detroit River by the United States to and from foreign ports, including the Canal Zone.

Canadian Exports and Imports refers to the shipping trade between the United States and Canada.

Coastwise Shipping refers to domestic traffic involving transportation over the ocean, e.g., Chicago to Boston.

Lakewise Shipping refers to traffic between U.S. ports on the Great Lakes System.

Internal Shipping refers to traffic involving carriage on both inland waterways and the waters of the Great Lakes System.

Local commerce includes movement of freight within the confines of a single arm or channel of a port, or within the limits of a port having only one project, arm, or channel, except ferries. The term is also applied to marine products, sand, and gravel taken from the Great Lakes.

under their direction is handled by their own equipment and personnel or is contracted out to low bidders. Figures 1-II and 2-II show the areas of new work and maintenance dredging operations along with the designated disposal sites.

New Work

Trenton Channel

The Trenton Channel, on the west side of the Detroit River and nine miles in length, flows in a southerly direction between the Michigan mainland on one side and Grassy Island, Michigan and Grosse Ile, Michigan on the other side. The Wyandotte Reach of the Trenton Channel extends from the junction with the Detroit River at the head of Fighting Island; downstream to the Grosse Ile toll bridge. The Trenton Reach extends further downstream in the natural channel on the west side of Grosse Ile to the turning basin at the City of Trenton.

The work scheduled by the Corps of Engineers for improvement of the Trenton Channel provided for the following:

a. A channel 300 ft. wide and 27 ft. deep in the Wyandotte Reach, extending for a distance of about six miles from the Detroit River through channel to a point just downstream of the Grosse Ile toll bridge.

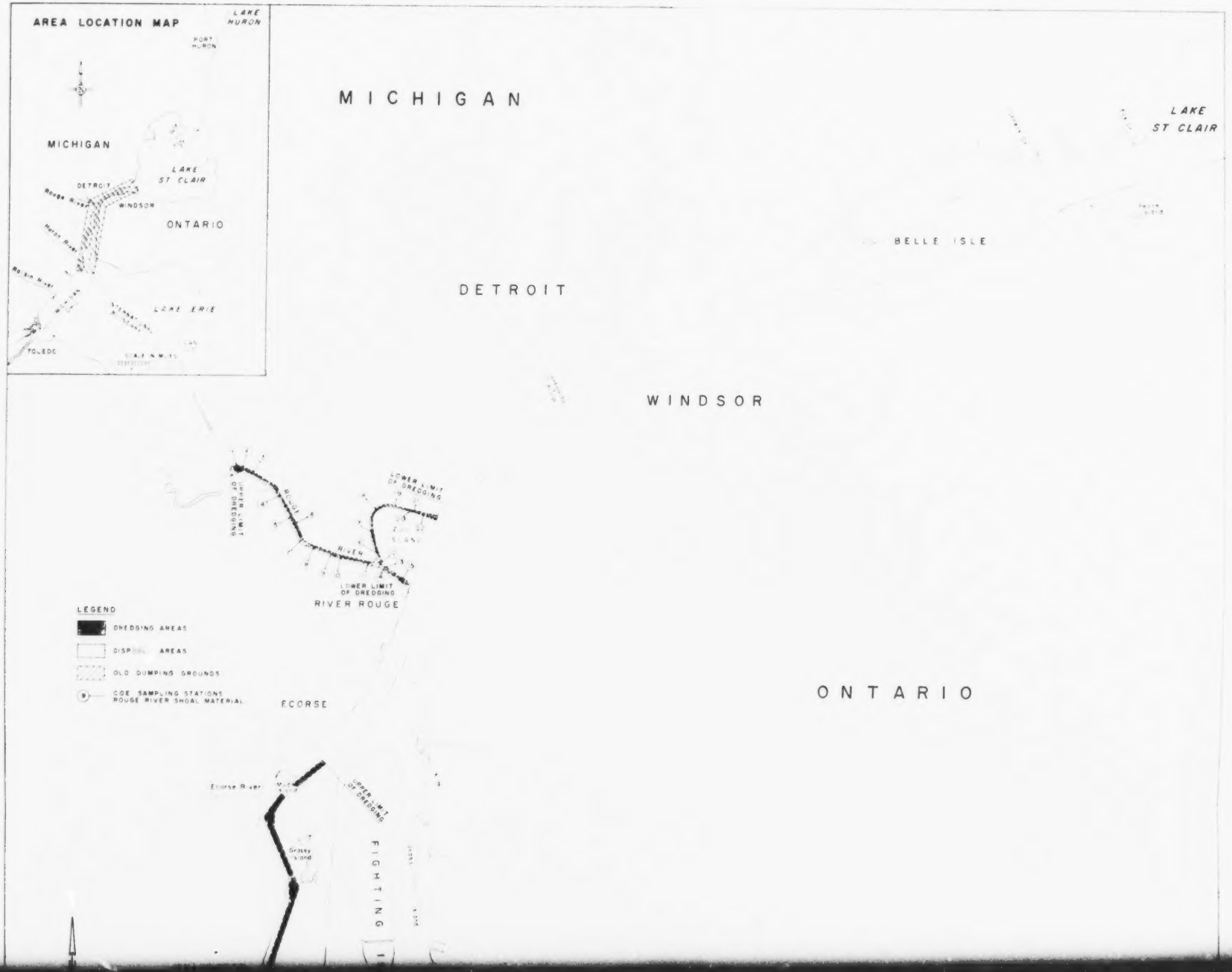
b. A channel 300 ft. wide and 28 ft. deep in Trenton Reach, extending for a distance of about one mile from the 27-foot deep channel just downstream of the Upper Grosse Ile Bridge to, and including, a turning basin 28 feet in depth and about 15 acres in area outside the dredging project channel limits at the McLouth Steel Corporation dock.

The Corps of Engineers divided this work into three sections for purposes of bidding and awarding of contracts. These sections are as follows:

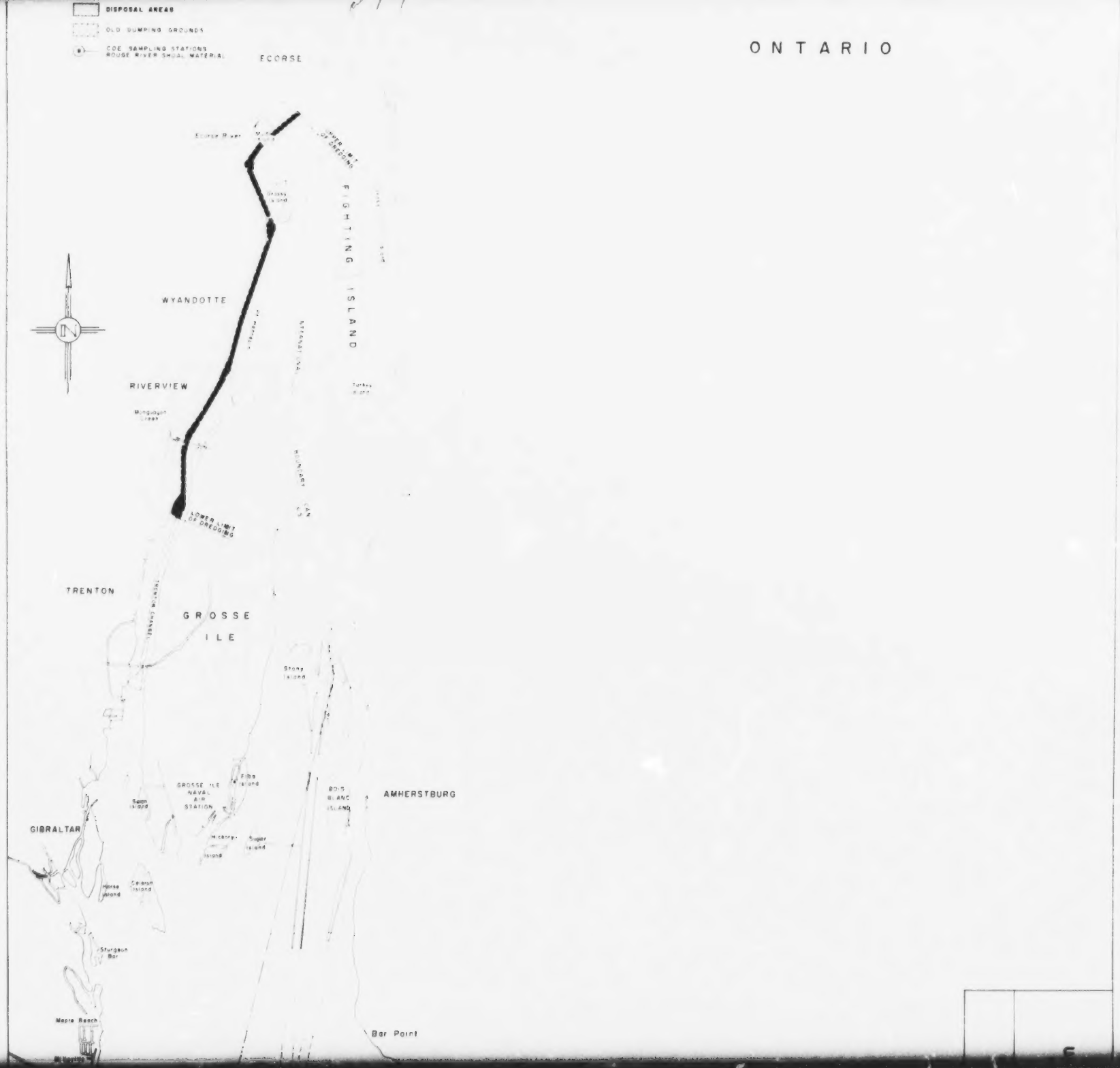
Section A - Comprising all of the work required in 6,450 feet of the Wyandotte Reach. The materials in this section to be excavated consist principally of sand, clay and gravel, which are being pumped into the Mud Island dike by a 20-inch hydraulic pipeline dredge. The pay quantity for this section was calculated as 180,000 cubic yards and a contract amounting to $299,810 awarded to Price Brothers - McClung Division, Price Brothers Company, Dayton, Ohio. Work began around mid-April 1963 and was completed during the month of June 1963.

Section B - Comprising all of the work in the lower 22,450 feet of the Wyandotte Reach between the lower end of the Upper Wyandotte Reach and a point approximately 700 feet downstream of the Grosse Ile toll bridge. The excavated material in this section also consists principally of sand, clay and gravel and comprises a pay quantity of 124,600 cubic yards. This material was deposited in a dump area located in Lake Erie south of the Detroit River Light between the West Outer Channel and East Outer Channel. This work was contracted to Peter Kiewit Sons Company, Omaha, Nebraska.

Section C - Comprising all of the work required between a point approximately 700 feet downstream of the Grosse Ile toll bridge and a point approximately 5,800 feet downstream of the bridge, including the turning basin. This section consists principally of a limestone ledge rock with a sand, gravel, clay and silt overburden. A portion of the material, 100,000 cubic yards was hauled by dump and/or deck scows to Mud Island where it was rehandled by a land-based plant in the construction of the Mud Island dike. The remaining 342,700 cubic yards of pay quantity was hauled to the Lake Erie Disposal area in dump scows. The contract for this section was awarded to the Dunbar and Sullivan Dredging Company, Detroit, Michigan. The cost of sections B and C together amounted to $4,491,036.


AREA LOCATION MAP
LAKE HURON
PORT HURON
MICHIGAN
LAKE ST CLAIR
DETROIT
Rouge River
WINDSOR
ONTARIO
Huron River
Raisin River
LAKE ERIE
TOLEDO
MICHIGAN
LAKE ST CLAIR
BELLE ISLE
DETROIT
WINDSOR
ONTARIO
UPPER LIMIT OF DREDGING
LOWER LIMIT OF DREDGING
RIVER
LOWER LIMIT OF DREDGING
RIVER ROUGE
LEGEND
DREDGING AREAS
DISPOSAL AREAS
OLD DUMPING GROUNDS
COE SAMPLING STATIONS ROUGE RIVER SHOAL MATERIAL
ECORSE
Ecorse River
UPPER LIMIT OF DREDGING
Grassy Island
FIGHTING

51a


DISPOSAL AREAS
OLD DUMPING GROUNDS
COE SAMPLING STATIONS
ROUGE RIVER SHOAL MATERIAL
ECORSE
ONTARIO
Ecorse River
UPPER LIMIT OF DREDGING
FIGHTING ISLAND
WYANDOTTE
RIVERVIEW
Turkey Island
LOWER LIMIT OF DREDGING
TRENTON
TRENTON CHANNEL
GROSSE ILE
Stony Island
GROSSE ILE NAVAL AIR STATION
Fibb Island
Sugar Island
BOIS BLANC ISLAND
AMHERSTBURG
GIBRALTAR
Horse Island
Celeron Island
Sturgeon Bar
Maple Beach
Bar Point

51 b

FIGURE I-II

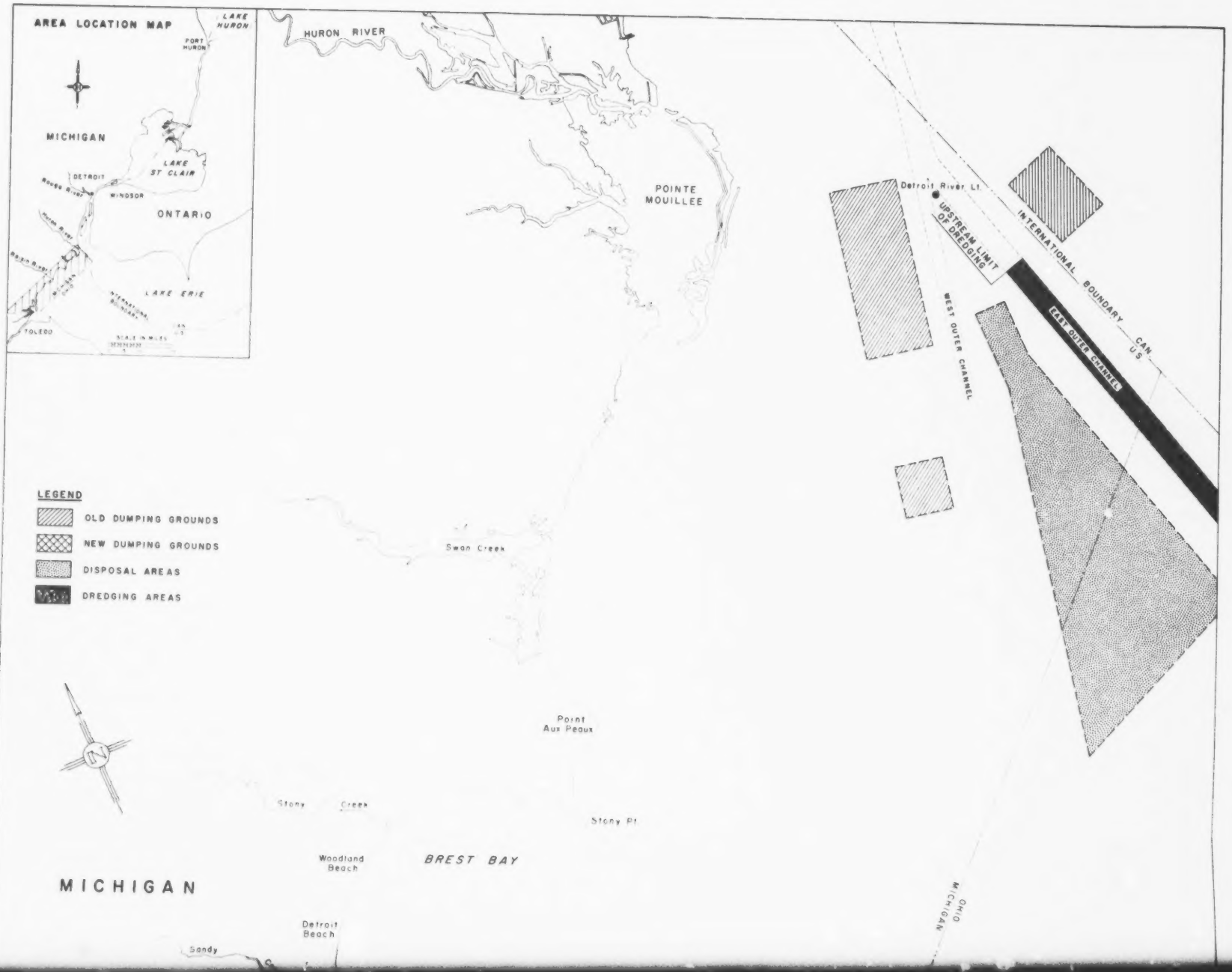
DETROIT RIVER-LAKE ERIE PROJECT

U.S. CORPS OF ENGINEERS DREDGING OPERATIONS AND DISPOSAL AREAS

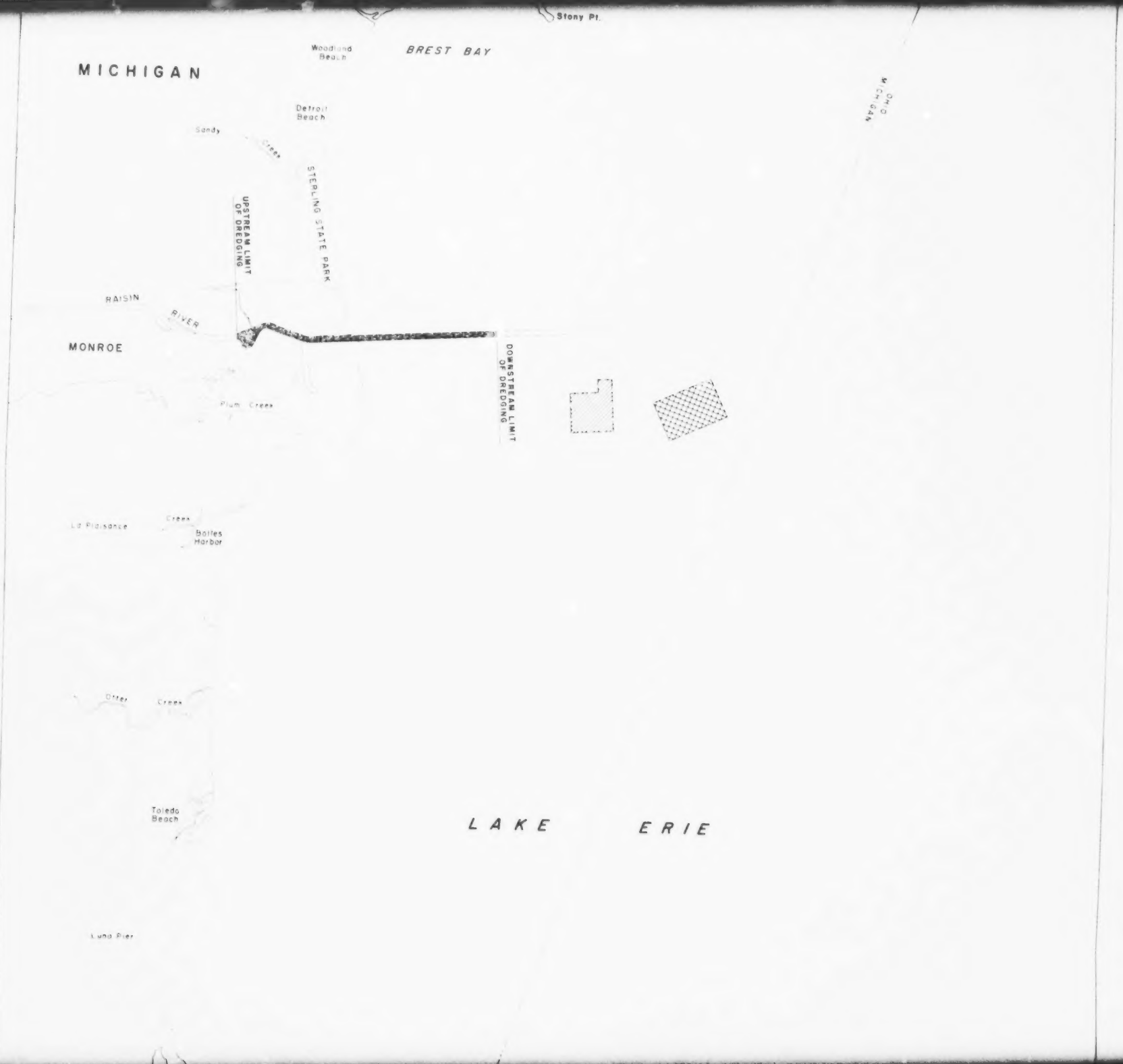
U.S. WATERS
DETROIT RIVER

U S DEPARTMENT OF HEALTH, EDUCATION, AND WELFARE
PUBLIC HEALTH SERVICE
REGION V GROSSE ILE, MICHIGAN

51 C


AREA LOCATION MAP
LAKE HURON
PORT HURON
MICHIGAN
LAKE ST CLAIR
DETROIT
WINDSOR
ONTARIO
LAKE ERIE
TOLEDO
HURON RIVER
POINTE MOUILLEE
Detroit River Lt.
UPSTREAM LIMIT OF DREDGING
INTERNATIONAL BOUNDARY
CAN
US
WEST OUTER CHANNEL
EAST OUTER CHANNEL
LEGEND
OLD DUMPING GROUNDS
NEW DUMPING GROUNDS
DISPOSAL AREAS
DREDGING AREAS
Swan Creek
Point Aux Peaux
Stony Creek
Stony Pt
Woodland Beach
BREST BAY
MICHIGAN
Detroit Beach
Sandy
OHIO
MICHIGAN

51d


Stony Pt.
Woodland Beach
BREST BAY
MICHIGAN
Detroit Beach
Sandy
Creek
STERLING STATE PARK
UPSTREAM LIMIT OF DREDGING
RAISIN
RIVER
MONROE
DOWNSTREAM LIMIT OF DREDGING
Plum Creek
La Plaisance
Creek
Bolles Harbor
Otter
Creek
Toledo Beach
LAKE
ERIE
Luna Pier
OHIO
MICHIGAN

5/6

FIGURE 2-II

DETROIT RIVER-LAKE ERIE PROJECT

U.S. CORPS OF ENGINEERS DREDGING OPERATIONS AND DISPOSAL AREA

LAKE ERIE

U.S. DEPARTMENT OF HEALTH, EDUCATION, AND WELFARE
PUBLIC HEALTH SERVICE
REGION V GROSSE ILE, MICHIGAN

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East Outer Channel

Dredging operations in the East Outer Channel were confined to an area 35,000 feet in length beginning about 6,000 feet down channel from the Detroit River Lighthouse. The pay quantity of excavated material in the channel was 2,769,000 cubic yards of clay with some sand and gravel. Disposal was in the dump ground located between the East and West Outer Channels. Work was under contract in September 1962 and completed in October 1962.

Maintenance Work

Rouge River

The dredging of the channels of the Main Rouge, Old Rouge and Short Cut Canal commencing at the Ford Motor Company turning basin and extending to the Detroit River is classified as maintenance work. Dredging operations are annual and commence about the middle of September and continue until just before Christmas. In 1962 approximately 174,000 cubic yards of silt, industrial waste and clay were removed and hauled by the U.S. Hopper Dredge Hains to Grassy Island and pumped within the diked area. In 1963, 255,000 cubic yards were removed. Table 2-II represents a summary of the average chemical constituents of the Rouge River shoal material as reported by the Corps of Engineers.

The costs of maintenance dredging by the Corps of Engineers in the Rouge were $206,288 in 1962 and $258,524 in 1963. To help defray the cost of dredging various industries were charged an amount (see Table 3-II) commensurate with the cost of removing that portion of the dredged material deposited by industrial waste discharges.

Detroit River

The Corps of Engineers removes some 100,000 cubic yards annually from the Livingstone Channel and 200,000 cubic yards annually from the East Outer Channel. The upper Livingstone Channel annual maintenance dredging is primarily carried out to remove diked material (rocks and boulders) which wave action has caused to topple into the channel. The lower Livingstone Channel and the East Outer Channel operation consists of removal of solids originating upstream and deposited in areas where the velocity decreases as the river approaches and enters Lake Erie.

Raisin River

Monroe Harbor dredging is classified as maintenance work and in 1962 and 1963 consisted of dredging from the Monroe Harbor terminal turning basin to a point about 8,000 feet into Lake Erie. This is an annual operation and usually takes place during the month of October. Two hundred and seventy one thousand cubic yards of excavated material consisting principally of silt, paper pulp and clay were hauled by the U.S. Hopper Dredge Hoffman to a disposal area in Lake Erie in 1962. Similar operations were repeated in 1963 with 390,000 cubic yards of material being removed by the U.S. Hopper Dredge Lyman.

The costs of maintenance dredging by the Corps of Engineers in the Raisin River were $58,774 in 1962 and $128,536 in 1963. To help defray the cost of dredging in the Raisin River, the Consolidated Paper Co. is charged a fixed annual fee of $5,000.

TABLE 2-II. CHEMICAL CONSTITUENTS ROUGE RIVER SHOAL MATERIAL

RESULTS EXPRESSED IN PERCENT OF SAMPLE

Location No.[2]	1962 Fe_2O_3	1962 CaO	1962 MgO	1962 Al_2O_3	1962 Carbon & Organic Loss on Ignition	1962 Insol. Sil.Mat.	1963 Fe_2O_3	1963 CaO	1963 MgO	1963 Al_2O_3	1963 Carbon & Organic Loss on Ignition	1963 Insol. Sil. Mat.
1	17.4	3.4	4.1	1.1	16.8	55.4	13.9	10.6	1.5	5.9	18.6	47.2
2	11.6	4.6	5.2	6.8	20.9	49.2	13.5	7.0	1.2	5.3	19.6	51.9
3	21.9	2.5	2.7	1.7	19.0	52.0	13.7	8.3	1.1	6.3	19.7	49.3
4	13.8	1.1	4.3	6.1	17.7	55.3	20.4	4.3	1.6	4.7	20.0	46.5
5	16.1	4.8	2.1	3.8	21.2	51.8	22.9	3.4	1.3	4.9	22.0	42.8
6	15.7	4.5	1.8	6.8	21.1	49.8	10.5	4.3	1.7	1.8	18.3	63.1
7	18.6	3.3	3.9	3.1	21.6	49.2	16.6	4.1	1.2	4.2	21.4	51.2
8	16.2	6.1	Tr	2.7	20.6	52.3	17.9	3.8	1.5	9.1	18.4	47.1
9	12.5	5.0	1.3	2.2	17.4	61.1	10.0	8.1	1.0	1.4	12.8	64.8
10	17.4	4.9	3.6	1.3	22.8	48.3	9.0	5.5	1.0	1.7	15.3	66.8
11	12.3	6.0	Tr	4.1	22.0	55.3	10.2	5.1	1.1	1.8	20.8	60.0
12	6.1	13.2	Tr	0.1	42.7	37.5	7.6	7.0	Tr	1.3	35.9	47.8
13	2.6	10.3	2.1	2.1	42.3	40.0	9.6	6.7	1.7	1.8	39.6	39.9
14	8.4	8.0	7.6	4.4	22.9	48.1	5.9	8.7	Tr	3.4	31.5	49.2
15	5.1	4.2	7.3	10.7	22.0	50.5	12.0	9.2	1.0	1.2	33.1	40.0
16	3.4	11.2	2.1	0.8	29.0	53.1	10.1	8.6	1.6	1.5	42.9	34.2
17	4.9	11.7	2.6	3.0	21.7	55.7	8.0	6.8	1.0	1.0	30.3	52.2
18	5.5	6.6	1.7	4.2	22.3	59.1	6.2	8.3	1.1	1.8	22.2	59.5
19	5.4	6.8	1.0	4.4	17.0	64.7	2.5	6.6	1.3	1.9	17.8	69.1
20	6.7	8.1	1.0	5.9	9.1	69.0	7.6	10.2	1.8	1.8	26.0	52.0
21	5.5	10.0	2.3	5.6	14.5	61.7	10.5	20.2	1.6	0.7	29.2	37.2
22	6.9	7.2	2.7	3.1	17.9	61.7	7.9	12.6	1.2	1.4	23.3	52.8

1. Data furnished by the Corps of Engineers
2. See Figure 1-II

TABLE 3-II. PARTICIPATING COSTS - ROUGE RIVER MAINTENANCE DREDGING

Industry	Year	Amount
Ford Motor Company	1962	17,051.11
	1963	35,671.83
Scott Paper Company	1962	1,836.54
	1963	8,701.66
Allied Chemical Corporation-Solvay Process Division	1962	4,469.49
	1963	5,379.53
American Cement Corporation-Peerless Cement Division	Fixed Annual Charge	3,500.00

FISH AND WILDLIFE

Sport Fishing

Values of the Detroit River sports fishery are taken from the Michigan Department of Conservation general creel census records, 1928 - 1963 (Table 4A-II). Seven principal species are caught by anglers. In order of importance, these are: yellow perch, white bass, rock bass, walleye (also called yellow pike and pickerel), sheepshead (or freshwater drum), smallmouth bass, and northern pike. The first four of these species constituted about 90 per cent of the total catch for the period 1928-1963: perch-49%, white bass-20%, rock bass-13%, walleye-9%.

In 1963, angling quality, as expressed in catch of fish per hour of angling, was five times higher than the composite average of 1.3 fish per hour. Species composition of the 1963 catch did not follow the usual pattern, however. Fifty percent of the catch was white bass; the remainder was composed of about half perch and half smelt. Only 2 percent of the catch was walleye, compared with the composite catch of 8 percent. There is a definite migration of this highly prized species between Lake Erie and Lake St. Clair, as tagging studies have demonstrated.

The sport fishery, especially in the lower Detroit River, has a high potential resource value. This was indicated by a study done by the Michigan Department of Conservation in 1952. The Institute for Fisheries Research in its report, "The Fish Fauna and the Fishing of the Detroit River in Vicinity of Sugar and Stony Islands" (1952), summarizes results of the netting survey and other analyses. Game fish, belonging to 12 different species, composed 55 percent of the adult population. There was a good variety and abundance of forage fishes on which game fishes feed. Neither the population of rough fishes, such as carp and gizzard shad, nor the population of obnoxious fishes such as the dogfish (or bowfin) and the gars, were too large. (The parasitic sea lamprey is not found in the River or Lake.)

The study also established that the several species of game fish grew at well above the growth rate of these species in inland waters of Michigan, and that angling quality in the Grosse Ile area compared favorably with angling quality of other Michigan non-trout waters. A netting survey, made by the Institute for Fisheries Research in the spring of 1964 to supplement the 1952 survey of the area, substantiated the conclusion that the fish population of the lower Detroit River is a valuable resource for sport fishing (communication from the Institute's director, dated July 2, 1964).

In Michigan waters of Lake Erie, a large variety of species are caught by sportsmen, as the composite creel census data for the period 1928 - 1963 show (Table 4B-II). The catch over this period has been composed predominantly of perch (72 percent). Rock bass, bull heads, white bass, and walleye rank next in order of importance. The 1963 census data indicates high angling quality, with a catch per hour of angling at 4 fish, compared with the composite catch per hour of 1.5 fish. But all the fish caught were of one species--yellow perch. Similarly, in 1960, 97 percent of the catch was perch; in 1961, 70 percent was perch. In 1962, only about a third of the catch was perch, with white bass constituting another third and rock bass about a fifth of the catch. The valued walleye composed only 3 percent of the 1962 catch, and it was absent from the 1960, 1961, and 1963 catches. Factors contributing to recent changes in the species composition of the Lake Erie fishery will be discussed in a later section of this report.

Commercial Fish Catches

Records of the Michigan Department of Conservation over the last 18 years show significant variations in the amount of catch of various species of fish. Catches from Lake Erie by Michigan fishermen for scattered years in the last two decades expressed in pounds of fish presented in Table 4-II. The fish are not necessarily caught in the Michigan waters of Lake Erie since the fishermen living in the State of Michigan may enter into Lake Erie waters of other States.

Records obtained from the Michigan Department of Conservation date back through 1944.

The figures show interesting rises and declines in the fish catches. Fish showing a definite decline through the years are the bowfin, northern pike and the sauger. Others such as the bullhead, catfish, sheepshead, white bass, and yellow pike exhibit fluctuations in catch through the years, while the yellow perch and carp show a definite rising trend in the catch. Lake Erie also yielded good catches of whitefish, lake herring, and ciscoe until the turn of the century when their population was decimated.

Waterfowl

The Detroit River is known as a major staging area for migrations of canvasbacks, redheads, scaups, and black ducks, using the Atlantic and Mississippi flyways. As a canvasback feeding area, the Detroit River is in a class with the famous marshes of Chesapeake Bay. In the Great Lakes region, the area is considered among the few remaining areas providing significant waterfowl habitat. The principal reason for this is the estimated 6,000 acres of shoal water on the American side of the Detroit River between the Ambassador Bridge and the head of Lake Erie, which contain preferred natural waterfowl foods such as wild celery, coontail, water milfoil, various pondweeds, and waterweed. The celery beds constitute one of the few good winter feeding grounds for the canvasbacks in the Great Lakes region. Associated with these plant beds are snails and other crustaceans which are important animal foods for the diving ducks.

Biologists from the Department of Interior's Bureau of Sport Fisheries and Wildlife and the Michigan Conservation Department have conducted serial surveys of waterfowl use in the Detroit River between the Ambassador Bridge and Lake Erie during various seasons. Since 1950, the minimum winter duck population was 5,000 in the 1961-62 period and the maximum population of approximately 100,000 in the winter of 1963-64. Approximately 24,000 were observed during the 1962-63 season. The minimum spring population of 14,000 was found in 1949-50 and the maximum of 70,000 in 1954-55. The fall season is divided into the three periods of pre-waterfowl, mid-waterfowl and post-waterfowl seasons. The minimums and maximum along with their respective years are as follows:

Pre-waterfowl season - 4,400 (1952-53) to 12,200 (1949-50)

Mid-waterfowl season - 5,500 (1959-60) to 293,000 (1953-54)

Post-waterfowl season - 25,500 (1954-55) to 95,000 (1952-53)

During the last few years, the canvasback variety has accounted for approximately 65 percent of the waterfowl using the area.

The Wyandotte National Wildlife Refuge was established by Public Law 87-119, dated August 3, 1961. This game refuge is located on Grassy and Mamajuda Islands in the lower Detroit River. This refuge is in addition to the 2600-acre game preserve at Pointe Mouillee.

TABLE 4-II. COMMERCIAL FISH CATCHES IN LAKE ERIE BY MICHIGAN FISHERMEN

Pounds of Fish

Fish	1944	1948	1952	1957	1961	1962	1963
Blue Pike		19,651	248				
Bowfin	8,345	8,076	1,200		10		
Buffalo					803	4,097	13,934
Bullheads	47,422	51,154	16,153	52,288	8,983	7,132	3,545
Burbot	31	146		50			
Carp	599,265	533,885	893,325	620,354	1,297,792	1,275,626	833,241
Catfish	35,397	27,111	27,686	56,536	85,557	51,646	40,533
Chubs							
Garfish							
Gizzard Shad			1,080		1,489		
Goldfish	1,482	699	50				
Lake Herring							
Lake Trout							
Lake Whitefish	669	9,491	729				
Mooneyes			442				
Menominee Whitefish							
Northern Pike		10,439	2,014	2,161	1,190	79	71
Rock Bass	2,920	7,902	520	520	654	251	3
Round Whitefish							
Saugers	5,898	4,419	802	145			
Sheepshead	120,828	80,327	32,388	64,637	94,494	82,292	71,321
Smelt					12		
Sturgeon					68	61	42
Suckers					62,259	56,471	60,905
White Bass	54,668	32,865	65,488	45,029	159,341	210,201	126,121
White & Red-Horse Suckers	35,194	41,733	27,496	19,128			
Yellow Perch	19,775	17,480	40,522	109,204	103,608	96,875	89,701
Yellow Pike	225,878	402,908	285,130	288,509	105,094	52,912	93,047
Total	1,157,772	1,248,286	1,395,273	1,258,561	1,921,354	1,837,643	1,332,464
Value			$122,078.45	$109,032.95	$145,159.68	$101,618.13	$94,594.30

TABLE 4 A-II. GENERAL CREEL CENSUS RECORDS FOR MICHIGAN WATERS OF THE DETROIT RIVER, 1961-1963, WITH 1928-1963 TOTAL*

Year	Number of Anglers	Total Hours	Fish	Catch per Hour	Small-mouth Bass	Large-mouth Bass	Blue gill	Pump-kin-seed	Rock Bass	Crap-pies	Perch	Walleye
1961	477	1,290	3,773	2.92	44	-	-	1	250	-	3,126	58
1962	122	210	1,440	6.86	-	-	7	-	2	-	341	21
1963	No records											
Total (1928-63)	4,236**	12,979	17,503	1.35	260	37	24	20	2,266	36	8,453	1,370

Year	Northern Pike	Bull-heads	Channel Catfish	Carp	Suckers	Smelt	Fresh-water Drum	Bur-bot	Bass	Chub	Sauger	Red-horse	Muskel-lunge	Dog fish
1961	52	-	29	9	-	4	25	-	173	-	-	-	1	1
1962	-	-	10	-	-	295	44	-	720	-	-	-	-	-
1963	No records													
Total (1928-63)	192	28	52	31	29	417	716	4	3,486	1	74	4	2	1

* Tabulation prepared by Institute for Fisheries Research, Michigan Department of Conservation, to supplement creel census table, 1928-60, published in "Joint Federal-State of Michigan Conference on Pollution of the Navigable Waters of the Detroit River, Lake Erie, and their Tributaries within the State of Michigan," Transcript of First Session, March 27, 1962, Vol. II, Part 1, pp. 391-392.

** Number of anglers not recorded in 1928 and 1929.

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TABLE 4-B-II. GENERAL CREEL CENSUS RECORDS FOR MICHIGAN WATERS OF LAKE ERIE, 1961-63, WITH 1928-1963 TOTAL*

Year	Number of Anglers	Total Hours	Fish	Catch per Hour	Rock Bass	Yellow Perch	Wall-eye	Northern Pike	Bull-heads	Channel Catfish	Carp	White Bass	Fresh-water-Drum
1961	47	300	571	1.90	2	404	-	-	-	101	64	-	-
1962	173	526	1,186	2.25	266	416	32	-	-	-	-	441	27
1963	79	160	640	4.00	-	640	-	-	-	-	-	-	-
Total (1928-63)	9,787**	38,019	37,001	1.50	4,269	40,924	1,365	1,171	3,497	327	634	2,776	989

Year	Small-mouth Bass	Large-mouth Bass	Blue-gill	Pumpkin-seed	Crappies	Dogfish	Shad	Sucker	Redhorse	Goldfish	Sauger
1961	-	-	-	-	-	-	-	-	-	-	-
1962	4	-	-	-	-	-	-	-	-	-	-
1963	-	-	-	-	-	-	-	-	-	-	-
Total (1928-63)	178	39	141	477	153	3	3	40	1	10	3

* Tabulation prepared by Institute for Fisheries Research, Michigan Department of Conservation, to supplement creel census table, 1928-60, published in "Joint Federal-State of Michigan Conference on Pollution of the Navigable Waters of the Detroit River, Lake Erie, and their Tributaries within the State of Michigan," Transcript of First Session, March 27, 1962, Vol. II, Part 1, pp. 391-392.

** Number of anglers not recorded in 1928 and 1929.

AREA LOCATION MAP
LAKE HURON
MICHIGAN
LAKE ST CLAIR
DETROIT
WINDSOR
ONTARIO
LAKE ERIE
TOLEDO
MICHIGAN
DETROIT
WINDSOR
LAKE ST CLAIR
BELLE ISLE
LEGEND
RECREATION AREAS
RIVER ROUGE
ECORSE
ONTARIO

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RECREATION AREAS

RIVER ROUGE

ECORSE

ONTARIO

WYANDOTTE

RIGHTING ISLAND

RIVERVIEW

TRENTON

GROSSE ILE

AMHERSTBURG

GIBRALTAR

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FIGURE 3-II

DETROIT RIVER-LAKE ERIE PROJECT

RECREATION AREAS AND MARINA FACILITIES

U.S. WATERS
DETROIT RIVER

U.S. DEPARTMENT OF HEALTH, EDUCATION, AND WELFARE
PUBLIC HEALTH SERVICE
REGION V GROSSE ILE, MICHIGAN

SCALE

FEET

MILES

AREA LOCATION MAP
LAKE HURON
PORT HURON
MICHIGAN
LAKE ST CLAIR
DETROIT
ROUGE RIVER
WINDSOR
ONTARIO
LAKE ERIE
TOLEDO
SCALE IN MILES
LEGEND
RECREATION AREAS
HURON RIVER
Lagotte Boat Livery
Pointe Mouillee Marina
Boyd's Marina
POINTE MOUILLEE
Detroit River Lt
INTERNATIONAL BOUNDARY
CAN
US
Swan Creek
Point Aux Peaux
Stony Creek
Stony Pt
Woodland Beach
BREST BAY
MICHIGAN
Detroit Beach
Sandy Creek
OHIO
MICHIGAN

Fig. 1

Aux Peaux
Stony
Creek
Stony Pt
Woodland Beach
BREST BAY
MICHIGAN
Detroit Beach
Sandy
Creek
STERLING STATE PARK
OHIO
MICHIGAN
RAISIN
RIVER
MONROE
Plum Creek
La Plaisance
Creek
Bolles Harbor
Otter
Creek
Toledo Beach
LAKE ERIE
Luna Pier

59/e

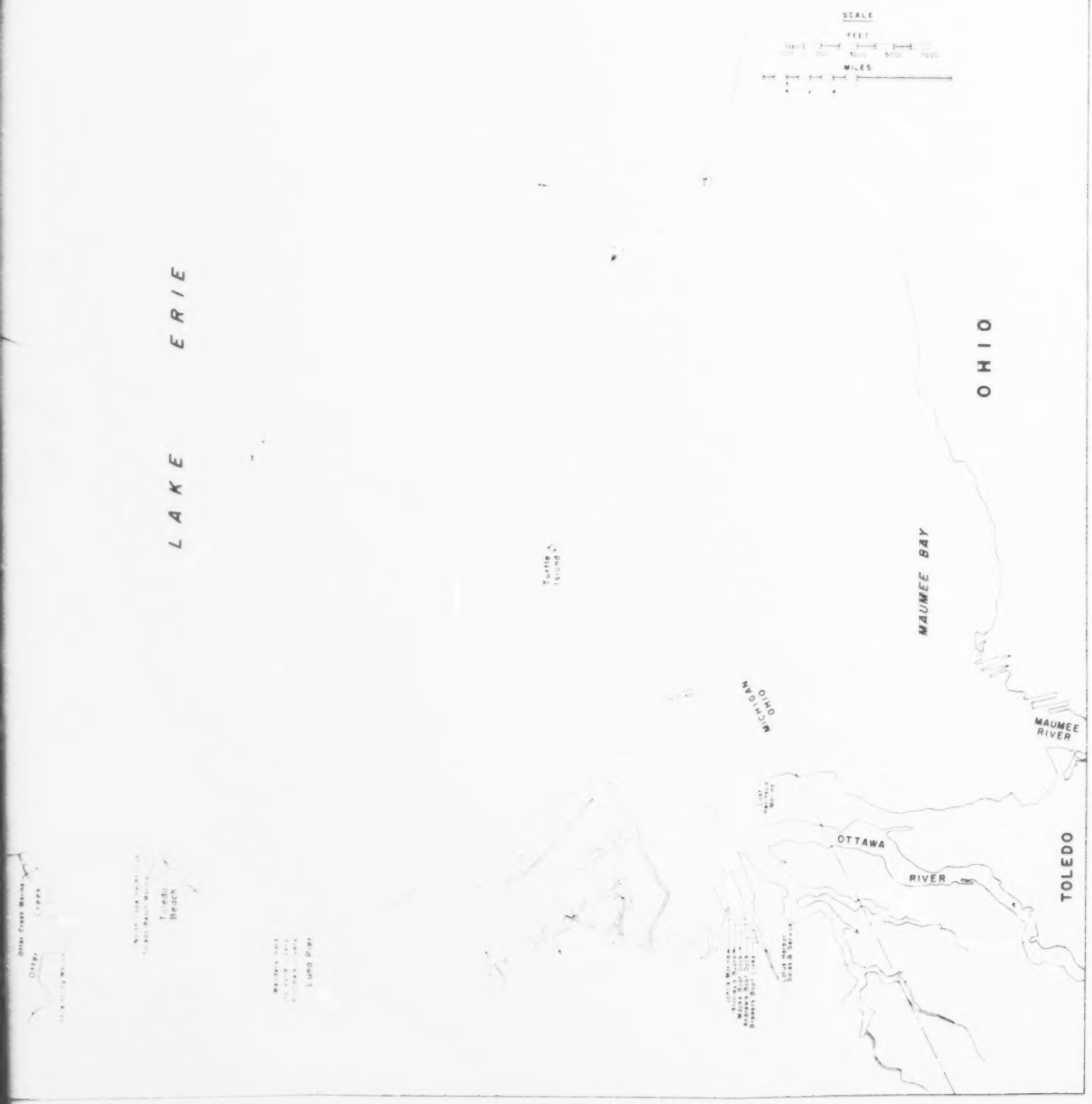
FIGURE 4-II

DETROIT RIVER-LAKE ERIE PROJECT

RECREATION AREAS AND MARINA FACILITIES

LAKE ERIE

U.S. DEPARTMENT OF HEALTH, EDUCATION, AND WELFARE
PUBLIC HEALTH SERVICE
REGION V GROSSE ILE, MICHIGAN



A major duck kill caused by pollution in the Detroit River in 1960 destroyed approximately 12,000 birds. The Michigan Department of Conservation records contain no report of duck kills attributable to pollution during the past three years.

RECREATIONAL USES

Recreational Areas

The majority of the recreational areas within the Project's limits are tabulated in Table 5-II and presented in Figures 3-II and 4-II. Facilities are divided into five geographical areas, numbered Area I - V, with approximate boundaries as follows:

Area I The shoreline between Windmill Point and confluence of the Detroit River with the Rouge River.

Area II The shoreline of the Detroit River between the Rouge and Ecorse Rivers.

Area III The shoreline of the Detroit River and Lake Erie between the Ecorse and Huron Rivers.

Area IV The Lake Erie shoreline between the Huron and Raisin Rivers.

Area V The Lake Erie shoreline between the Raisin River and the Michigan-Ohio line.

The facilities listed in column 5 are general, and in some cases may not be complete. The code explanation is as follows:

A - Athletic facilities (tennis, baseball, etc.)
Am - Amusement facilities (ferris wheel rides, etc.)
Bh - Bathhouse
C - Concession stand
D - Dance pavilion
F - Fishing area
G - Golf course and/or driving range
L - Extensive landscaping
M - Marina facilities and boat rentals
Mu - Music facilities (bandstand, music shell)
Pa - Picnic areas
Pg - Playground (children's equipment, etc.)
R - Boat Ramp
Sb - Swimming (beach)
Sp - Swimming (pool)
Wp - Wading pool or spray pool

Marina Facilities

One of the fastest growing recreational uses of water in the Detroit area, as well as in the entire United States, is pleasure boating. Figures presented by the Outboard Boating Club of America show that over $2,500,000,000 was spent on recreational boating in the United States in 1962 as compared with $720,000,000 a decade earlier.

An evaluation of the use of the Detroit area water resources for pleasure boating can be obtained by tabulating the various indicators of boating popularity such as marina facilities, boat registrations and boat launchings.

TABLE 5-II. RECREATIONAL AREAS

AREA I

PARK AREA	OWNERSHIP	WATER FRONTAGE	AREA (ac)	FACILITIES	ATTENDANCE (Year)	ESTIMATED (1) VALUE ($)
Riverside Playfield	City of Detroit	870 ft.	10.2	R PG		474,000.00
Gabriel Richard Park	City of Detroit	1,638 ft.	21.9	Pg A L		G8,000,000.00
Owen Park	City of Detroit	427 ft.	8.2	Pg L		G100,000.00
Detroit Memorial Park	City of Detroit	1,181 ft.	33.3	M a Wp		1,570,500.00
Stockton Park	City of Detroit	300 ft.	2.75	L		G10,000.00
Engel Park	City of Detroit	663 ft.	34.32	A Pa R L		G857,000.00
Peter Maheras Playfield	City of Detroit	1,232 ft.	53	A Pa		G420,000.00
Brush Ford Park	City of Detroit	2,928 ft.	33.3	Pa Pg		650,000.00
Lakewood East Park	City of Detroit	Included in Above	28.0	M		Included in above
Belle Isle	City of Detroit	Island	927	Sb Mu A G C Pa Pg M	12,000,000 (1959)	G55,000,000.00

TABLE 5-II. RECREATIONAL AREAS (CONTINUED)

PARK AREA	OWNERSHIP	WATER FRONTAGE	AREA (ac)	FACILITIES	ATTENDANCE (Year)	ESTIMATED VALUE ($)
AREA II						
Henry Belanger Park	City of River Rouge	644 ft.	10	R C Pg	75,000	600,000.00
Ecorse Park	Wayne County		3	L	200,000	
AREA III						
Bishop Park	City of Wyandotte	1260 ft.	9.2	A Wp Mu		7,500.00
Riverview Municipal Marina	City of Riverview	85 ft.		R		
Elizabeth Park	Wayne County	3600 ft.	162	Pa Pg A R	750,000	
AREA IV						
Sterling State Park	State of Michigan	7800 ft.	624	Sb C Bh Pa	911,246('60) 1239,216('59)	
Kress Park	Private	400 ft.		Pa Bh Pg		
AREA V						
Toledo Beach	Private	600 ft.		Pa Sb Am		

TABLE 6-II. MARINA FACILITIES SUMMARY

AREA I

Marina Name	Address	# of Boat Wells	# of Boats in Summer	Living Aboard	# Boats with Treat. Devices	Type of Water Supply	# of Toilet Facil-ities	Type of Treatment	# of Rental Boats
Bayview Yacht Club	Ft. of Clairpoint Detroit	69	65	0	0	City	5	Det STP	0
Browns Marina	14455 Riverside Detroit	16	16	0	0	City	2	Det STP	0
Detroit Boat Basin	9666 E. Jefferson Detroit	200	200	0	3	City	4	Det STP	0
Detroit Boat Club	Belle Isle	72	72	0	0	City	17	Det STP	0
Detroit Yacht Club	Belle Isle	284	284	15	N.A.	City	14	Det STP	0
Edison Boat Club		25-40	25-40	0	N.A.	City	3	Det STP	0
Gregory Marina		129	129	0	N.A.	City	4	Det STP	0
Keans Detroit Yacht Harbor	100 Meadowbrook Detroit	300	250	0	5-10	City	2	Det STP	0
Memorial Park Marina		274	274	6-30	some	City	1	Det STP	0
Harbor Hill Marina		60	35	0	0	City	1	Det STP	0
Roostertail Marina	100 Marquette Detroit	88	88	0	1	City	3	Det STP	0
Sinbads Marina	100 St. Clair Detroit	104	100	0	0	City	2	Det STP	0
Sinbads Marina Inc.	11200 Freud Detroit	226	226	2	0	City	2	Det STP	0

TABLE 6-II. MARINA FACILITIES SUMMARY (CONTINUED)

AREA I

Marina Name	Address	#of Boat Wells	# of Boats in Summer	Living Aboard	# Boats with Treat. Devices	Type of Water Supply	# of Toilet Facilities	Type of Treatment	# of Rental Boats
St. Clair Sail Club	Just North of Gregorys	30	24	0	0	City	2	Det STP	0
Windmill Point Boat Co.	14301 Riverside Detroit	62	62	0	NA	City	0	Det STP	0
Woodhaven Area (Private Homes)		79	79	0	NA	City	0	Det STP	0
Windmill Pt. Area (Private Homes)		130	130	0	NA	City	0	Det STP	0

TABLE 6-II. MARINA FACILITIES SUMMARY

AREA II

Marina Name	Address	# of Boat Wells	# of Boats in Summer	Living Aboard	# Boats with Treat. Devices	Type Water Supply	# of Toilet Facil-ities	Type of Treatment	# of Rental Boats
Ecorse Boat Basin	4685 W. Jefferson Ecorse	68	68	0	0	City	1	Septic Tank	0
Nicks Marina	4409 W.Jefferson Ecorse	53	53	0	0	City	1	Septic Tank	0

TABLE 6-II. MARINA FACILITIES SUMMARY

AREA III

Marina Name	Address	# of Boat Wells	# of Boats in Summer	Living Aboard	# Boats with Treat. Devices	Type of Water Supply	# of Toilet Facil-ities	Type of Treatment	# of Boat Rentals
Andy's Boat Harbor	St. John & Perry Pl, Wyan.	5	70	0	10	City	0	Wyan STP	0
Hidden Boat Harbor	693 Biddle Wyandotte	100	100	0	0	Wyan	2	Wyan STP	0
Johnsons Marina	Wyandotte	54	54	0	0	Wyan	20	Wyan STP	0
Mellins Marina	653 Biddle Wyandotte	75	45	0	NA	Wyan	2	Wyan STP	0
Pier 500	507 Biddle Wyandotte	75	75	0	0	Wyan	4	Wyan STP	0
Holdens Boat Works	2775 Riverside Trenton	15	14	0	0	Det	0	None	0
Howey's Boat Works	2751 Riverside Trenton	40	40	0	0	Det	2	None	0
Liggett Boat Works	2965 Riverside Trenton	45	45	0	0	Det	1	Tren STP	0
Humbug Marina	N. Adams Drive Gibraltar	200	200	0	0	City	2	Tren STP	0
Gibraltar Boat Yard	13770 Blakeley Gibraltar	70	70	0	0	City	2	Tren STP	0
Vicks Boat Livery		9	9	0	0	City	1	Wyan	0
Elba Mar Yacht Club	23117 E. River Grosse Ile	26	26	0	0	City	2	Septic T	0
Ford Yacht Club	29500 S.Pointe Grosse Ile	185	185	0	100	City	5	Septic T-	0

TABLE 6-II. MARINA FACILITIES SUMMARY

AREA III (CONTINUED)

Marina Name	Address	# of Boat Wells	# of Boats in Summer	Living Aboard	# Boats with Treat. Devices	Type of Water Supply	# of Toilet Facil-ities	Type of Treatment	# of Boat Rentals
Naval Air Station	Grosse Ile	50	65	0	2	City	2	Cesspool	8
Grosse Ile Yacht Club	29677 Hickory Grosse Ile	121	120	0	80	City	7	Septic T	0
Hoovers	28821 E. River Grosse Ile	50	50	0	NA	Well	3	Septic T	40
Island Boat & Country Club	25215 W. River Grosse Ile	60	60	0	0	City	10	Septic T	0

TABLE 6-II. MARINA FACILITIES SUMMARY

AREA IV

Marina Name	Address	# of Boat Wells	# of Boats in Summer	Living Aboard	# Boats with Treat. Devices	Type of Water Supply	# of Toilet Facil-ities	Type of Treatment	# of Rental Boats
Bellinos Marina		100	50	0	0	Well	2	Septic T	52
Detroit Beach Boat Club		105	31	0	NA	Well	2	Septic T	0
Lezotte Boat Livery	Pointe Mouillee	10	10	0	0	Well	1	Septic T	6
Pointe Mouillee Marina	37245 Pt. Mouillee, Rockwood	36	25	0	0	Well	2	Septic T	26
Swan Boat Club		38	30	2	0	Well	2	Septic T	0

TABLE 6-II. MARINA FACILITIES SUMMARY

AREA V

Marina Name	Address	# of Boat Wells	# of Boats in Summer	Living Aboard	# Boats with Treat. Devices	Type of Water Supply	# of Toilet Facil-ities	Type of Treatment	# of Rental Boats
Andrew's Boat Dock	2937 E. Sterns N. Maumee Bay	50	50	0	NA	Pump	1	Privy	0
Bloome's Livery	Luna Pier	0							12
Bolles Harbor Boat Livery	7970 Harbor Rd. Bolles Harbor	108	108	Boats 12	0	Creek	1	Septic T	0
Brewers Boat Livery	2881 E. Sterns N. Maumee Bay	Docks 134	50-75			Pump	1	Privy	2
Callahans Boat Livery	7976 Harbor Rd. La Plaisance Cr.	30	20	0	0	Pump	1	Septic T	5
Du Valle Livery	4346 LaPointe Dr. Luna Pier								20
Harbor Marine	13951 Bridge Dr. La Plaisance Cr.	25	25			Pump	None		0
Joe's Boat & Bait	13468 N. La Plaisance	14	10	0	0	Pump	1	Septic T	15
John's Marina	7330 Perch Drive N. Maumee Bay	125	100	0		Pump	1	Septic T	3
L & E Boat Livery	13961 N. La Plaisance	Docks 22	22	0	0	None	None		6
Lost Peninsula Marina		124				None	None		
Lotus Harbor Sales & Service	7120 Summit St. Halfway Creek	275	275	0		Pump	1	Septic T	10
Macks Boat Dock	2941 E. Sterns N. Maumee Bay	5 20 at Docks	5	0		Pump	1	Privy	0

TABLE 6-II. MARINA FACILITIES SUMMARY

AREA V (CONTINUED)

Marina Name	Address	# of Boat Wells	# of Boats in Summer	Living Aboard	# Boats with Treat. Devices	Type of Water Supply	# of Toilet Facil-ities	Type of Treatment	# of Rental Boats
Meaders Band	10712 Lakeside Luna Pier								14
Monroe Boat Club	La Plaisance Creek	75	75	25 Boats	1	Pump	1	Septic T	0
Monroe Marina	6647 La Plaisance Rd.	50	50	5 Boats	0	Pump	1	Septic T	0
North Cape Yacht Club	Near Toledo Beach	70 und. constr.				Pump	1	Septic T?	
Otter Creek Marina	Otter Creek	34				Pump	1	Privy	
Shoe String Marina	5800 S. Otter Creek	14 26 by 1964		0	0	Pump	1	Septic T	0
Stanley's Boats	2947 E. Sterns N. Maumee Bay	45	45	0		Pump	1	Privy	0
Straits Boat Livery	8528 E. Dunbar Plum Creek	12	12	0		Pump	1	Chemical T.	14
Toledo Beach Marina	North of Toledo Beach	150 600 ultimately				Pump	1	Septic T.	30

The major marinas and the number of boat wells they represent are tabulated in Table 6-II and presented in Figures 3-II and 4-II. The areas into which the facilities are located contain the same boundaries as those areas in the preceding section.

Boat Registrations and Launchings

Of the five counties chosen for the boat registration figures, all but Oakland County have shorelines on Lake St. Clair, the Detroit River, or Western Lake Erie. The northwest suburbs of Detroit are in Oakland County, and for this reason the boat registrations for this county are also included in the list.

Exact boat launching figures for the Wyandotte Municipal Ramp and the Elizabeth Park ramp are available because a charge is levied at these ramps which necessitates the keeping of launching records. There are other free public launching ramps along the River for which usage figures are not available.

Boat Registrations[1]

Macomb County	18,057
Monroe County	5,899
Oakland County	37,302
St. Clair County	7,744
Wayne County	74,842
Total	143,844

Boat Launchings - Wyandotte Municipal Boat Ramp[2]

1961	5,847
1962	5,382

Boat Launchings - Elizabeth Park Marina Trenton[3]

1961	8,974
1962	8,418

Boat Launchings - Detroit Engel Parks Ramps[4]

1962 Season	18,000 (estimate)

INDUSTRIAL WATER USES

The information summarized in Table 7-II is a compilation on the use of water by Michigan industries in the study area. Figures 5-II and 6-II locate the points of waste discharge from each industry. The order of presentation is basically geographical, with

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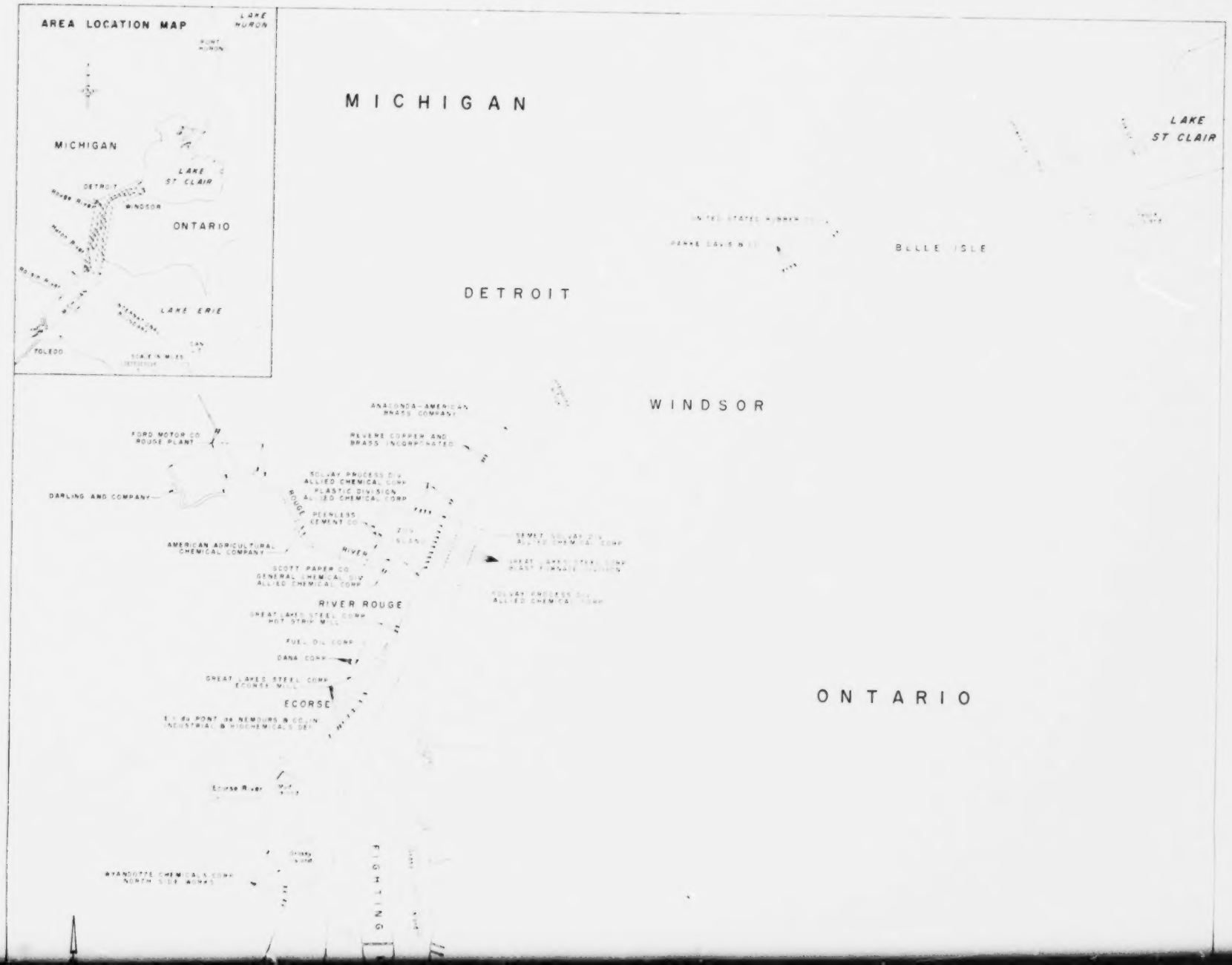
[1] Michigan Department of State, through September 30, 1962.
[2] City of Wyandotte, 1962 figures are through October 15, 1962.
[3] Wayne County Board of Road Commissioners, through October 6, 1962.
[4] City of Detroit Department of Parks and Recreation.


AREA LOCATION MAP
LAKE HURON
MICHIGAN
LAKE ST CLAIR
DETROIT
WINDSOR
ONTARIO
LAKE ERIE
TOLEDO
MICHIGAN
LAKE ST CLAIR
BELLE ISLE
DETROIT
WINDSOR
ONTARIO
ANACONDA-AMERICAN BRASS COMPANY
REVERE COPPER AND BRASS INCORPORATED
FORD MOTOR CO ROUGE PLANT
DARLING AND COMPANY
SOLVAY PROCESS DIV ALLIED CHEMICAL CORP
PLASTIC DIVISION ALLIED CHEMICAL CORP
PEERLESS CEMENT CO
ROUGE
RIVER
AMERICAN AGRICULTURAL CHEMICAL COMPANY
SCOTT PAPER CO GENERAL CHEMICAL DIV ALLIED CHEMICAL CORP
RIVER ROUGE
GREAT LAKES STEEL CORP HOT STRIP MILL
FUEL OIL CORP
DANA CORP
GREAT LAKES STEEL CORP ECORSE MILL
ECORSE
Ecorse River
WYANDOTTE CHEMICALS CORP NORTH SIDE WORKS
FIGHTING

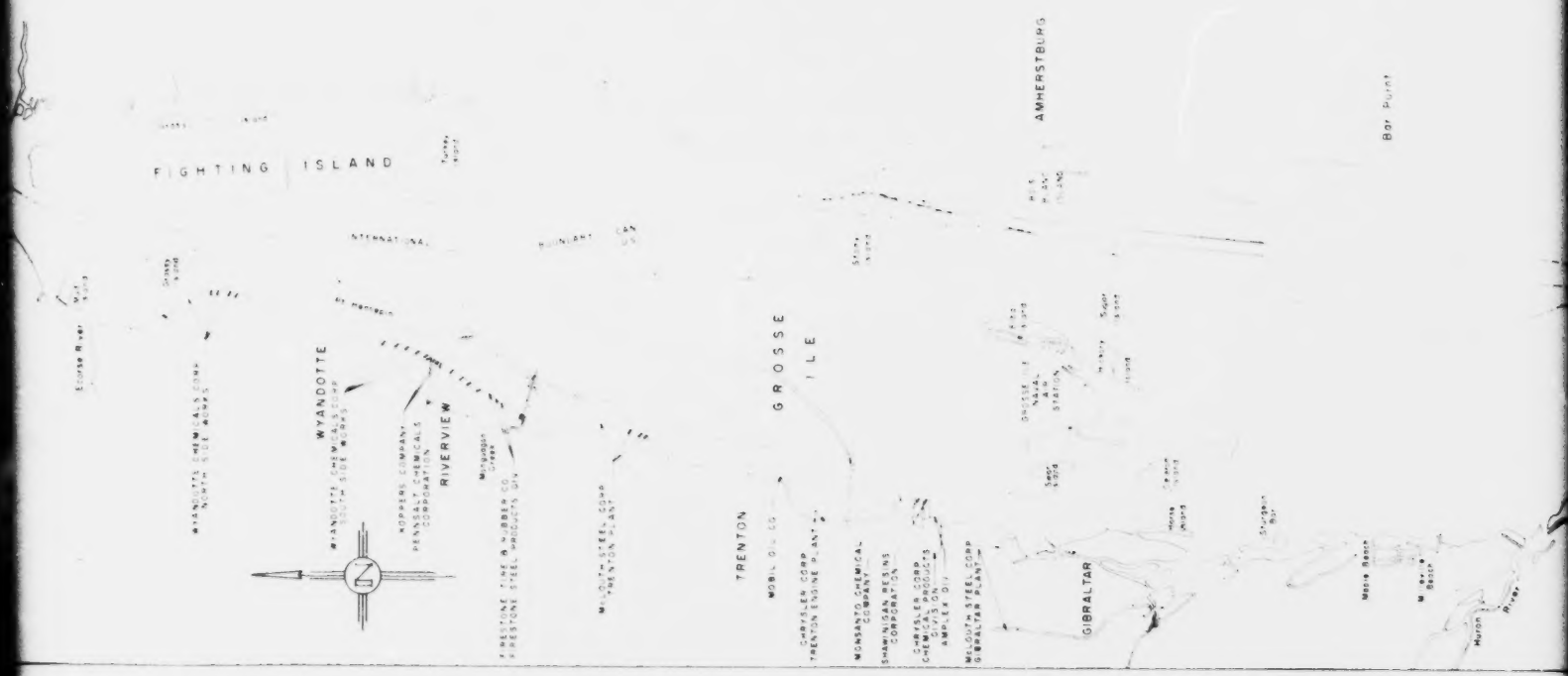
71a

DE ROIT

INDUSTRI

U S DEPARTMENT

REGION



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71 c

FIGURE 5-II

DETROIT RIVER-LAKE ERIE PROJECT

INDUSTRIAL WASTE OUTFALLS

U.S. WATERS
DETROIT RIVER

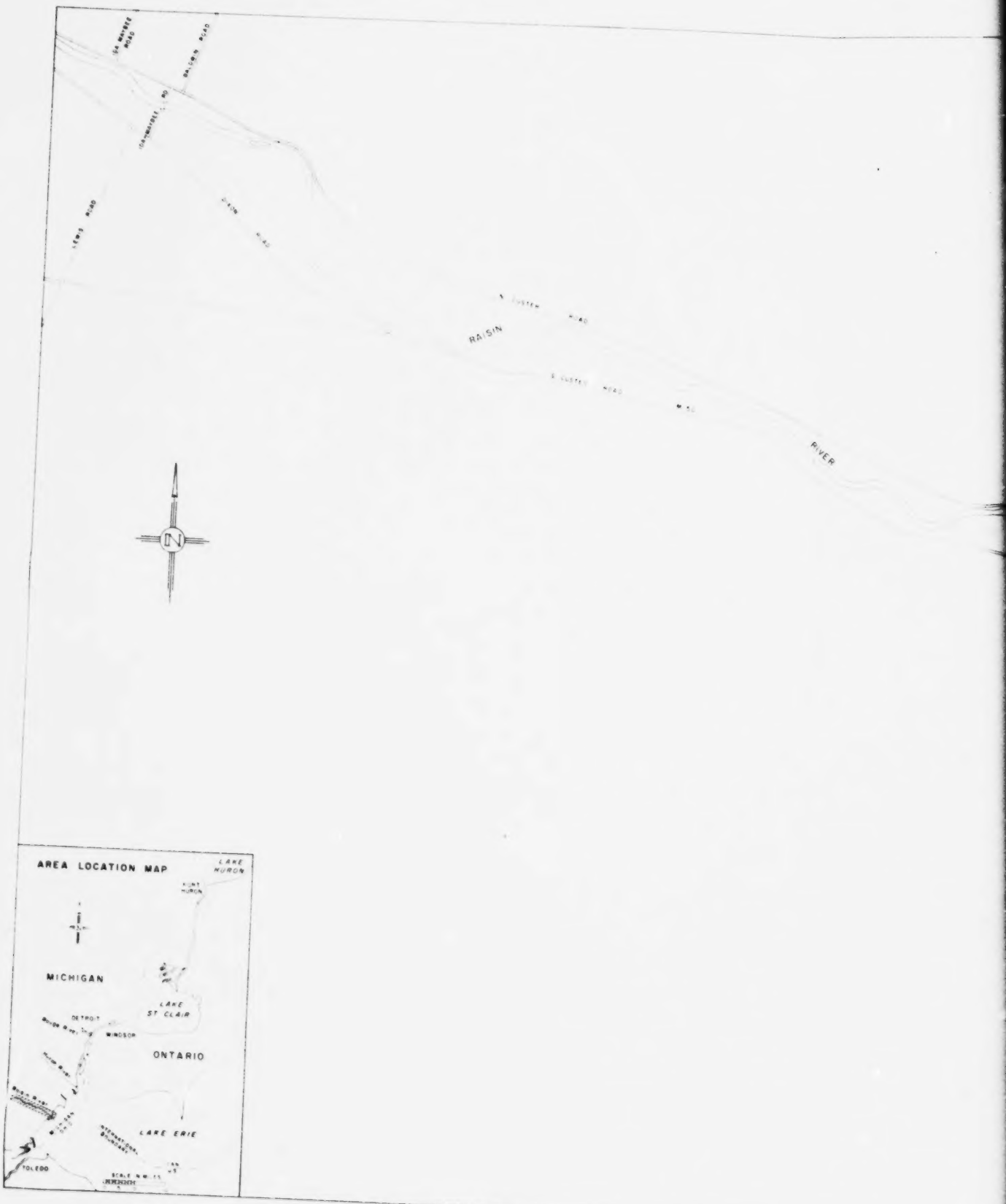
U.S. DEPARTMENT OF HEALTH, EDUCATION, AND WELFARE
PUBLIC HEALTH SERVICE
REGION V GROSSE ILE, MICHIGAN

SCALE

FEET

MILES

71 C


LEWIS ROAD
RAISIN
RIVER
N
AREA LOCATION MAP
LAKE HURON
MICHIGAN
LAKE ST CLAIR
DETROIT
WINDSOR
ONTARIO
LAKE ERIE
TOLEDO

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MICHIGAN

Stony Creek
Woodland Beach
RIVER
Detroit Beach
Stony Creek
MONROE PAPER PRODUCTS CO.
DAM
CONSOLIDATED PAPER CO. NORTH SIDE DIV.
UNION-BAG CAMP PAPER CO. RIVER RAISIN PAPER CO. DIVISION
CONSOLIDATED PAPER CO. WEST SIDE DIV.
MONROE
MONROE STEEL CASTING CO.
Mason Run
STERLING STATE PARK
MONROE AUTO EQUIPMENT CO.
CONSOLIDATED PAPER CO. SOUTH SIDE DIV.
FORD MOTOR CO.
MONROE SEWAGE TREATMENT PLANT
To Pleasance
BOLLES HARBOR

71 £

FIGURE 6-II

DETROIT RIVER-LAKE ERIE PROJECT

WATER INTAKE — DOMESTIC AND INDUSTRIAL WASTE OUTFALLS

MICHIGAN WATERS OF LAKE ERIE

U.S. DEPARTMENT OF HEALTH, EDUCATION, AND WELFARE
PUBLIC HEALTH SERVICE
REGION V GROSSE ILE, MICHIGAN

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data given first for plants on the Detroit River beginning at the headwaters and proceeding downstream, then the industries on the River Rouge, followed by data for those on the Raisin River. Space requirements have dictated the following coded information:

Columns 2 and 8 - Source and Discharge Point

Det Riv	- Detroit
Riv Rouge	- Main stem of River Rouge
Rouge SC	- Short cut canal of River Rouge
Rouge OC	- Old channel of River Rouge
UG	- Underground
City or City Sewer	- The water supply or treatment facilities of the municipality in which the plant is located.
Rais Riv	- Raisin River

Column 3 - Amount

gpm	- gallons per minute
gph	- gallons per hour
gpd	- gallons per day
mgd	- million gallons per day
mgy	- million gallons per year

Column 4 - Pre-treatment (treatment of water by the industry prior to use)

Scr	- Screening either course or fine
F	- Filtered
A	- Addition of alum
SA	- Addition of sodium aluminate
Chl	- Chlorination

Column 6 - Final Treatment (general treatment given wastewater prior to discharge into receiving waters)

AF	- Air Floatation
CC	- Chemical coagulation
Chl	- Chlorination
Cl	- Clarifier
DF	- Drum filter
Dis	- Distillation
Dp	- Dephenolizing equipment
E	- Excelsior filtration
GC	- Grit chamber
N	- Neutralization
OC	- Oil centrifuging
OWS	- Oil water separating apparatus
P	- Ponds
PS	- Primary settling
SS	- Sludge sintering
SSP	- Sub-surface percolation
St	- Sludge thickening

TABLE 7-II. INDUSTRIAL WATER SUPPLY AND WASTE DISPOSAL

DETROIT RIVER

Industry	Water				Waste		
	Source	Amount	Pre Treatment	Use	Final Treatment	Major Constituents	Discharge Pt.
Detroit Edison Conners Cr.	Det Riv	208,000 gpm (Max.)	Scr Chl	Cooling	None	T	Det Riv
	City			Potable & Sanitary			City Sewers
U.S. Rubber Co.	Det Riv	42 mgd		Process & Cooling	OWS		Det Riv
	City	0.5 mgd		Potable & Sanitary			City Sewers
Parke Davis & Co.	Det Riv	17.3 mgd		Cooling	None		Det Riv
	Det Riv	0.63 mgd		Process		SusS pH	City Sewers
	City	0.45 mgd		Potable & Sanitary			City Sewers
Anaconda American Brass Co.	Det Riv	5.3 mgd		Cooling & Process	N PS	pH O	Det Riv
	City	0.0625 mgd		Potable & Sanitary		Cn	City Sewers

TABLE 7-II. INDUSTRIAL WATER SUPPLY AND WASTE DISPOSAL (CONTINUED)

DETROIT RIVER

Industry	Water				Waste		
	Source	Amount	Pre Treatment	Use	Final Treatment	Major Constituents	Discharge Pt.
Mistersky Power Station	Det Riv			Cooling	None	T	Det Riv
	City			Potable & Sanitary			City Sewers
Revere Copper & Brass	Det Riv	2.9 mgd		Process	CWS	O Cu	Det Riv
	City	0.36 mgd		Potable & Sanitary			City Sewers
Detroit Edison Delray	Det Riv	190,000 gpm (Max.)	Scr Chl	Cooling	None	T	Det Riv
	City			Potable & Sanitary			City Sewers
Great Lakes Steel Blast Furnace	Det Riv	90 mgd	Chl	Process & Cooling	CC DF SC Dis Dp	P Fe SusS	Det Riv
	City	38,000 gpd		Potable & Sanitary	PS Chl		Det Riv
Allied Chem. Solvay Process	Det Riv	21.6 mgd		Process & Cooling	Cl P	SusS P N	Rouge OC & Det Riv
	City			Sanitary			City Sewers

TABLE 7-II. INDUSTRIAL WATER SUPPLY AND WASTE DISPOSAL (CONTINUED)

Detroit River

Industry	Water				Waste		
	Source	Amount	Pre Treatment	Use	Final Treatment	Major Constituents	Discharge Pt.
Detroit Edison River Rouge	Det Riv	480,000 gpm (Max.)	Scr Chl	Cooling	None	T	Det Riv
	City			Potable & Sanitary			City Sewers
Great Lakes Steel Strip Mill		42.13 mgd		Process	Cl SS PS	SS O T	Det Riv
		30.27 mgd		Cooling & Condens.	None		Det Riv
		100,000 gpd		Potable & Sanitary			County Sewers
Fuel Oil Corp.	City	12,240 gph		Vessel washing Batch operation	OWS & E	O SusS	Det Riv
Dana Corp.	City	0.384 mgd		Process & Cooling Sanitary & Potable	None	A pH Fe P	City Sewers Det Riv
Great Lakes Steel Ecorse	Det Riv	72 mgd	Chl	Cooling & Process	OWS P	A Fe SusS O	Det Riv
	City	1.1 mgd		Potable & Sanitary			County Sew Det Riv

TABLE 7-II. INDUSTRIAL WATER SUPPLY AND WASTE DISPOSAL (CONTINUED)

DETROIT RIVER

Industry	Water				Waste		
	Source	Amount	Pre Treatment	Use	Final Treatment	Major Constituents	Discharge Pts.
E. I. DuPont	Det Riv	1.4 mgd		Process & Cooling	None	Ph C	Det Riv
	City			Sanitary & Potable	Soil Absorption		
Wyandotte Chem. North Plt.	Det Riv	57 mgd		Process & Cooling	P on Fighting Island OWS	SusS O P N Cn	Det Riv
	City of Wyandotte			Sanitary & Potable			County Sewers
Wyandotte Chem. South Plt.	Det Riv	54.7 mgd		Process & Cooling	P OWS	C SS P O	Det Riv
	City			Potable & Sanitary			County Sewers
Koppers Co. Inc. Tar Prod. Div.	Det Riv	0.802 mgd		Cooling & Process	None	pH A P	County Sewer Det Riv
	City of Wyandotte	4500 gpd		Potable & Sanitary			County Sewers
Pennsalt Chem.Corp. Industrial Div.	Det Riv	97 mgd		Process & Cooling	None	N C SusS	Det Riv
	City of Wyandotte			Potable & Sanitary			County Sewers

TABLE 7-II. INDUSTRIAL WATER SUPPLY AND WASTE DISPOSAL (CONTINUED)

DETROIT RIVER

Industry	Water				Waste		
	Source	Amount	Pre Treatment	Use	Final Treatment	Major Constituents	Discharge Pt.
Pennsalt Chem.Corp. Organic Chem. Div.	Det Riv	6.77 mgd		Process & Cooling	CC OWS P	N S P pH O X	Monguagon Cr.
	City of Wyandotte			Potable & Sanitary			County sewers
Firestone Tire & Rubber Co.	Det Riv & City	1.03 mgd	A SA F	Process & Cooling	OWS P	A pH O Fe SusS	Det Riv
	City of Wyandotte	12,000 gpd (est)		Potable & Sanitary			County Sewers
McLouth Steel Trenton	Det Riv	65.67 mgd		Process & Cooling	GC CC Cl St OC SS	SusS O Fe T	Det Riv
	City	(1962) 2.282 mgy		Potable & Sanitary	2.06 mgd to Wayne Co		County Sewers
Mobil Oil Co.	Det Riv	1.12 mgd		Process & Cooling	Ps P OWS CC AF DF Dp	Salt P X O	Det Riv
	City			Potable & Sanitary			County Sewers
Chrysler Corp. Engine Plt.	City	75,000 gpd		Potable & Sanitary	Wayne Co		County Sewers
	City	1.1 mgd		Process & Cooling	OWS AF CC		Elizabeth Park Cr.

TABLE 7-II. INDUSTRIAL WATER SUPPLY AND WASTE DISPOSAL (CONTINUED)

DETROIT RIVER

Industry	Water				Waste		
	Source	Amount	Pre Treatment	Use	Final Treatment	Major Constituents	Discharge Pt.
Detroit Edison Trenton Channel	Det Riv	250,000 gpm (Max.)	Scr Chl	Cooling	None	T	Det Riv
	City			Potable & Sanitary			County Sewers
Monsanto Chemical	Det Riv	5.76 mgd		Cooling	P	T Phosphates	Det Riv
	City	12.5 mgd		Process			Det Riv
Shawinigan Resins Corp. & Monsanto Saflex Div.	Det Riv	383,000 gpd		Process & Cooling	P N	pH B SusS	Det Riv
	City	33,000 gpd		Potable & Sanitary			County Sewers
Chrysler Corp. Amplex Div.	Det Riv	0.317 mgd		Cooling	None		Det Riv
	City			Potable & Sanitary			County Sewers
Chrysler Corp. Cycleweld	Det Riv	0.265 mgd		Cooling	None		Det Riv
	City	5,000 gpd		Potable & Sanitary			County Sewers

TABLE 7-II. INDUSTRIAL WATER SUPPLY AND WASTE DISPOSAL (CONTINUED)

DETROIT RIVER

Industry	Water				Waste		
	Source	Amount	Pre Treatment	Use	Final Treatment	Major Constituents	Discharge Pt.
McClouth Steel Gibraltar	Det Riv	1.64 mgd		Process & Cooling	OWS P	A Fe O pH SusS	Frank & Poet Drain
	City	55 gpm		Potable & Sanitary			County Sewer

TABLE 7-II. INDUSTRIAL WATER SUPPLY AND WASTE DISPOSAL (CONTINUED)

ROUGE RIVER

Industry	Water				Waste		
	Source	Amount	Pre Treatment	Use	Final Treatment	Major Constituents	Discharge Pt.
Allied Chem. Semet-Solvay Div.	Det Riv	6 mgd	Scr	Process	Dp OWS	O P	Rouge OC
	City			Boilers	None		Det Riv
		1.12 mgd		Process	Dp	P O	Det Riv
				Sanitary			City Sewers
(Plastics Div.) Allied Chem.	Det Riv	0.475 mgd		Cooling & Process	Dp PS E	P O	Rouge OC
	City			Potable & Sanitary			City Sewers
Peerless Cement Co. East Plant	Riv Rouge	7.93 mgd		Cooling & Process	None	SusS	Rouge OC
	City			Potable & Sanitary			City Sewers
Scott Paper Co.	Rouge Riv	50 mgd	Lime Soda Softening	Process	Cl	B SusS A pH P	Rouge OC
	City			Potable & Sanitary			City Sewer

TABLE 7-II. INDUSTRIAL WATER SUPPLY AND WASTE DISPOSAL (CONTINUED)

ROUGE RIVER

Industry	Water				Waste		
	Source	Amount	Pre Treatment	Use	Final Treatment	Major Constituent	Discharge Pt.
Allied Chem. General Chem. Div.	Rouge Riv	9.11 mgd	Chl	Process	P	A pH	Rouge SC
	City			Potable & Sanitary	SSF		County Sewers
American Agric. Chem. Co.	Rouge Riv	0.577 mgd		Cooling & Process Potable & Sanitary	None	Fl pH	Rouge Riv
Ford Motor Co. Rouge Complex	Rouge OC	350-600 mgd	Scr	Cooling Process	GC Cl OWS ST DF	SusS P Cn N O pH	Riv Rouge & UG
	All Sources	913 mgd (1963)					
	City			Potable & Sanitary			City Sewers
Darling & Co.	Rouge Riv	1.13 mgd		Process & Cooling	Chl P	Bact SusS B N O	Rouge Riv

TABLE 7-II. INDUSTRIAL WATER SUPPLY AND WASTE DISPOSAL (CONTINUED)

LAKE ERIE

Industry	Water				Waste		
	Source	Amount	Pre Treatment	Use	Final Treatment	Major Constituents	Discharge PT.
Detroit Edison Enrico Fermi	Lake Erie	135,000 gpm		Cooling & Condensing	N.A.	T	Swan Cr. & Lake Erie
	Lake Erie	16,100 gpd		Demineralizing Regenerating			Swan Cr. & Lake Erie
		200 gpm		Potable & Sanitary			Swan Cr. & Lake Erie

TABLE 7-II. INDUSTRIAL WATER SUPPLY AND WASTE DISPOSAL (CONTINUED)

RAISIN RIVER

Industry	Water				Waste		
	Source	Amount	Pre Treatment	Use	Final Treatment	Major Constituents	Discharge Pt.
Ford Motor Co. Monroe	Lake Erie	2.0 mgd	F Chl	Cooling & Process	CC Cl		Raisin Riv
	Lake Erie	126 mgd		Dilution		Cn O	Raisin Riv
	Lake Erie	0.168 mgd	F Chl	Potable & Sanitary	PS Chl	Bact	Raisin Riv
Consolidated Paper Southside Plant	Lake Erie & Wells	7 mgd		Process	Cl	Bact SusS B	Raisin Riv
	City			Sanitary & Potable			City Sewer
River Raisin Paper		4.573 mgd		Process	CC Cl	SusS B	Mason Run
	City			Potable & Sanitary			City Sewer
Consolidated Paper Northside Plant	Lake Erie	7.533 mgd		Process	CC Cl	SusS B Bact	Mason Run& Raisin Riv
	City			Sanitary & Potable			City Sewer

TABLE 7-II. INDUSTRIAL WATER SUPPLY AND WASTE DISPOSAL (CONTINUED)

RAISIN RIVER

Industry	Water				Waste		
	Source	Amount	Pre Treatment	Use	Final Treatment	Major Constituents	Discharge Pt.
Consolidated Paper Westside Plant	Raisin Riv	1.15 mgd		Process	CC Cl		
	City			Sanitary & Potable		B	City Sewer
Monroe Auto Equipment Co.	City	0.0157 mgd		Process		O	Raisin Riv & City
	City			Potable & Sanitary			City Sewer
Monroe Paper Products	Raisin Riv	2.21 mgd		Process	CC Cl	SusS B Bact	Raisin Riv
	City			Potable & Sanitary			City Sewer

Column 7 - Major Constituents

A	- Acidity as $CaCO_3$
B	- Biochemical Oxygen Demand
C	- Chlorides
Cn	- Cyanide compounds
Cr	- Chromium compounds
Fe	- Soluble iron
Fl	- Fluorides
N	- Nitrogen compounds
O	- Oil
P	- Phenols
pH	- High or low pH values
S	- Sulfur compounds
SS	- Settleable solids
SusS	- Suspended solids
T	- High temperatures
X	- Ether extractables
Bact	- Coliform Bacteria

MUNICIPAL WATER USES

The data presented in Table 8-II have been extracted from the State of Michigan, Municipal Water Facilities Inventory as of January 1, 1963. This inventory was recently updated by the Michigan Department of Health to reflect changes which have occurred since the last published inventory of 1958. Locations of municipal water intakes in the study area are shown in Figures 6-II and 7-II.

Detailed Notes for Columns:

Column 1 - Community

Communities which serve one or more additional communities are preceded by an asterisk.

Column 3 - Estimated Population Served (1963)

This is the estimated total number of people served by the facility shown in Column 6 - Source of Supply. The number enclosed in parentheses indicates the people are served by some other facility.

Column 4 - Number of Accounts

This number represents the total number of accounts served by the facility.

Column 5 - Number of Meters

This number represents the total number of meters used in the water system.

Column 6 - Source of Supply

The following are the abbreviations used and for what they stand:

W.C.M.W.A. - Wayne County Metropolitan Water Authority.

W.C.M.W.S. - Wayne County Metropolitan Water Supply.

Column 7 - Rated Capacity

This figure is the maximum rated capacity (in MGD) on the basis of design, where possible.

Column 8 - Average Daily Output

This column contains the average daily output of the system during 1962 or the latest year of record if not otherwise noted.

Column 9 - Treatment

Where the treatment is extensive, or one or more symbols identifying the general type or function of the plant precede those used to identify the particular treatment plant or method. In general, a plant is not classified as a "purification plant" unless filters having fine granular material (sand or anthracite) are used.

Principal treatment features, identified by capitalized letters, are further described by lower case letters following them. In general, the symbols are arranged in the order in which treatment occurs. Combination units performing more than one function in a single structure are denoted by enclosing the appropriate symbols in parentheses. Enclosures in brackets indicate parallel or alternate operation.

Treatment methods are coded as follows:

Type of Plant

P - Purification
H - Softening
I - Iron or manganese removal

Treatment or Device

A - Aeration
Ac .. contact beds or trays, coke or other material
Am .. patented aerator
As .. spray aerator
At .. overflow trays cascade or other splash aerator
Ao .. other type aerator
Af .. forced draft aerator

C - Chemical dosage for coagulation or softening

Ca .. alum
Ci .. iron salts
Cl .. lime
Cs .. soda ash
Ct .. activated silica
Co .. other coagulant

D - Disinfection
Dc .. chlorine gas
Dd .. dechlorination
Dh .. hypochlorites
Ds .. free residual chlorine
Dx .. chlorine dioxide
Dz .. ozone
Do .. other means

F - Filters
- Fa .. anthrafilt
- Fe .. roughing or contact
- Fd .. diatomaceous earth
- Fg .. gravity (slow)
- Fp .. pressure
- Fr .. gravity (rapid)
- Fs .. sand
- Fz .. zeolite
- Fm .. micro strainers

K - Chemical dosage for corrosion correction or water stabilization
- Kc .. phosphate compounds
- Kg .. chlorine gas
- Kh .. hypochlorite
- Ko .. sodium silicate
- Kp .. alkali feed for pH adjustment

M - Mixing device or tank
- Ma .. air agitation
- Mb .. baffle mix
- Mh .. hydraulic (standing wave flume)
- Mi .. injection or pump suction
- Mp .. slow mechanical mix
- Ms .. patented sludge blanket
- Mt .. rapid mechanical mix
- (MtpsSv) .. "Liquon Reactor"; "Accelator"; or "Precipitator"

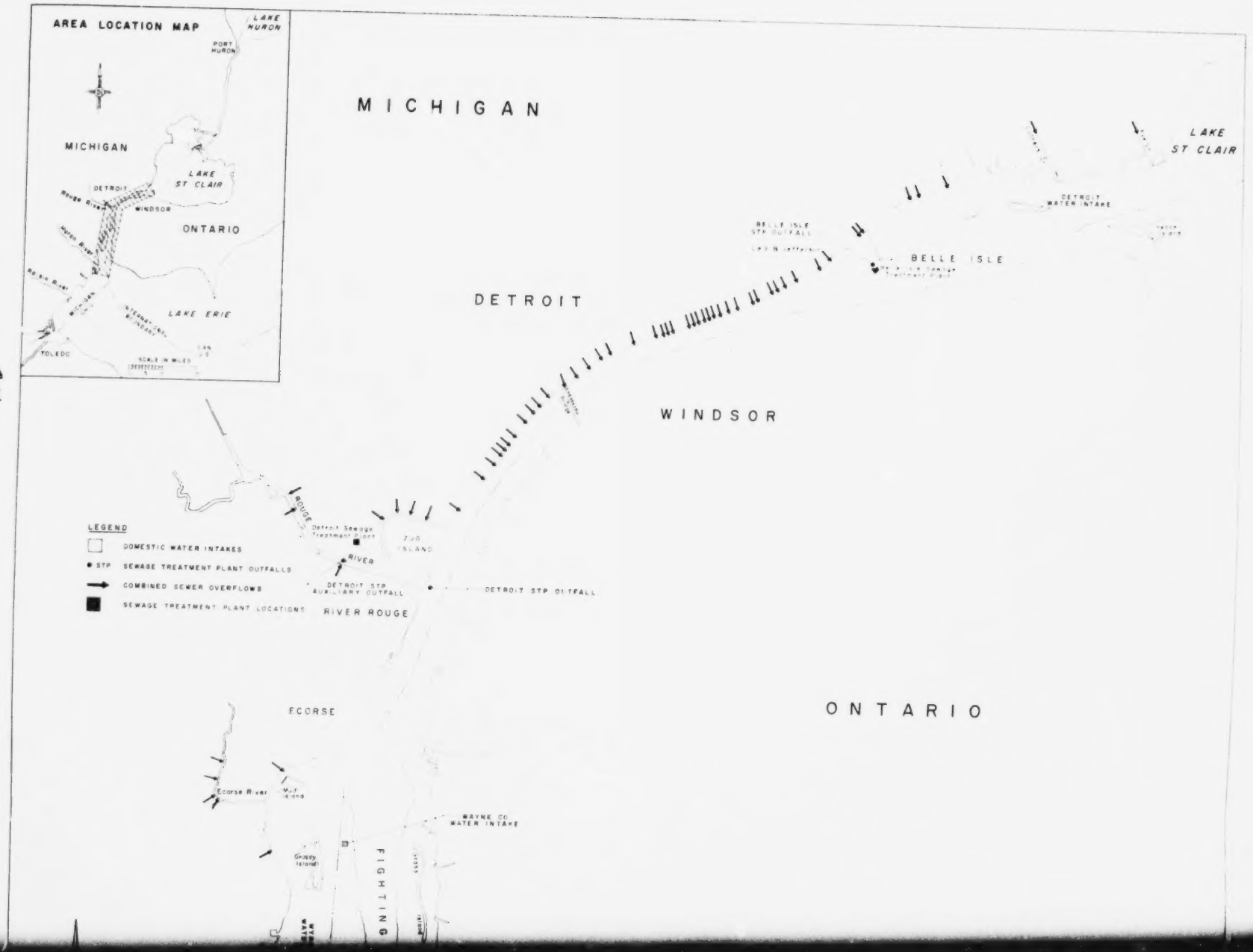
N - Ammoniation
- Nc .. ammonium compound
- Ng .. ammonia gas

R - Recarbonation

S - Sedimentation
- Sb .. basins, baffled (other than inlet or outlet)
- Sc .. covered basins (other than housed)
- Sm .. mechanical sludge removal
- So .. open basin (may be in plant building)
- Sv .. upflow cylindrical tanks
- (MtpsSv) .. "Liquon Reactor"; "Accelator"; or "Precipitator"

T - Chemical taste and odor control
- Tc .. activated carbon
- Td .. chlorine dioxide
- Ts .. sulfur dioxide
- Tz .. ozone
- To .. other

V - Fluoride adjustment
- Va .. hydrofluosilicic acid
- Vs .. sodium silicofluoride
- Vt .. sodium fluoride
- Ve .. ammonium silicofluoride
- Vo .. other fluorides
- V .. fluoride reduction
- $V_{1.2}$ - 1.2 ppm natural fluoride


AREA LOCATION MAP
LAKE HURON
PORT HURON
MICHIGAN
LAKE ST CLAIR
DETROIT
WINDSOR
ONTARIO
LAKE ERIE
TOLEDO
MICHIGAN
DETROIT
WINDSOR
ONTARIO
LAKE ST CLAIR
DETROIT WATER INTAKE
BELLE ISLE
LEGEND
DOMESTIC WATER INTAKES
STP SEWAGE TREATMENT PLANT OUTFALLS
COMBINED SEWER OVERFLOWS
SEWAGE TREATMENT PLANT LOCATIONS
ROUGE RIVER
Detroit Sewage Treatment Plant
ZUG ISLAND
DETROIT STP AUXILIARY OUTFALL
DETROIT STP OUTFALL
RIVER ROUGE
ECORSE
Ecorse River
WAYNE CO. WATER INTAKE
FIGHTING

84a

DE
DOM
SEW
COMB
U.
U.S. DEPA

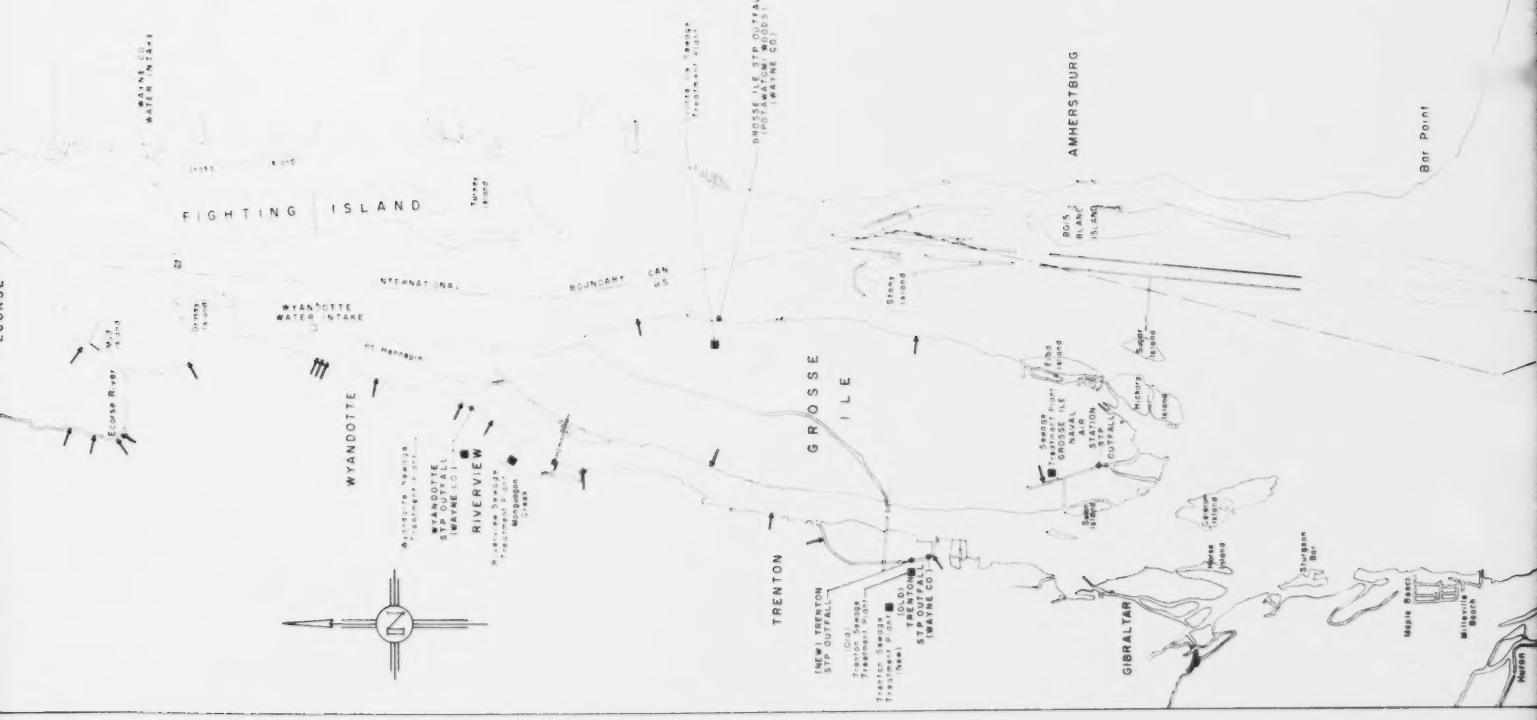


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FIGURE 7-II

DETROIT RIVER-LAKE ERIE PROJECT

DOMESTIC WATER INTAKES
SEWAGE PLANT OUTFALLS
COMBINED SEWER OVERFLOWS

U.S. WATERS-DETROIT RIVER

U.S. DEPARTMENT OF HEALTH, EDUCATION, AND WELFARE
PUBLIC HEALTH SERVICE
REGION V GROSSE ILE, MICHIGAN

87C

TABLE 8-II. MUNICIPAL WATER USE

Community	County	Estimated Population Served 1963	Number of Accounts	Number of Meters	Source of Supply	Rated Capacity (MGD)	Average Daily Output (MGD)	Treatment
Allen Park	Wayne	(37,900)	10,133	10,133	W.C.M.W.S.	-	-	-
Berkley	Oakland	(23,300)	6,618	6,618	S.E.O.W.A.	-	-	-
Beverly Hills	Oakland	(5,000)	x	x	S.E.O.W.A.	-	-	-
Birmingham	Oakland	(25,500)	7,716	7,716	S.E.O.W.A.	-	-	-
Brownstown Twp.	Wayne	(4,000)	364	364	Flat Rock W.C.M.W.S.	-	-	
Canton Twp.	Wayne	(300)	75	75	Detroit	-	-	
Centerline	Macomb	(10,200)	2,231	2,231	Detroit	-	-	
Clawson	Oakland	(14,900)	4,193	4,193	S.E.O.W.A.	-	-	
Dearborn	Wayne	(112,500)	32,366	32,366	Detroit	-	-	
Dearborn Twp.	Wayne	(79,800)	17,571	17,571	W.C.M.W.S.	-	-	
Detroit	Wayne	(3,211,600)	389,000	389,000	Detroit River	1114	487	P-Dc Ca Tc Mtbp Sc Frs Dc
Detroit Water Wks. Pk. Plt.		760,000 ('58)				320	191 ('58)	
Detroit Spring-wells Plt.		673,000 ('58)				452	163 ('58)	

TABLE 8-II. MUNICIPAL WATER USE (CONTINUED)

Community	County	Estimated Population Served 1963	Number of Accounts	Number of Meters	Source of Supply	Rated Capacity (MGD)	Average Daily Output (MGD)	Treatment
Detroit Northeast Plt.		477,000 ('58)				192 ('63)	115 ('58)	
Detroit Southwest Plt.		200,000			Detroit River	150	75 (est)	
East Detroit	Macomb	(45,800)	12,482	12,482	Detroit	-	-	
Ecorse	Wayne	(17,400)	4,505	4,505	Detroit			
Farmington	Oakland	(6,900)	2,137	2,137	Detroit			
Farmington Twp.	Oakland	(2,900)	780	780	Detroit			
Ferndale	Oakland	(31,400)	9,745	9,745	Detroit			
Flat Rock	Wayne	7,000			Huron River		1.0	P-Dc Calo (MtpsSV) Frs Dc Kc
Garden City	Wayne	(38,300)	9,506	9,506	W.C.M.W.S.	-	-	
Gibraltar	Wayne	(2,500)	835	835	W.C.M.W.S.	-	-	
Grosse Ile Twp.	Wayne	(6,700)	1,770	1,770	W.C.M.W.S.	-	-	
Grosse Pointe Pk.	Wayne	(15,400)	3,995	3,995	Detroit	-	-	
Grosse Pointe Shores	Wayne	(2,400)	725	725	Detroit	-	-	

TABLE 8-II. MUNICIPAL WATER USE (CONTINUED)

Community	County	Estimated Population Served 1963	Number of Accounts	Number of Meters	Source of Supply	Rated Capacity	Average Daily Output	Treatment
Grosse Pointe Woods	Wayne	(16,800)	5,563	5,563	Detroit	-	-	
Hamtramck	Wayne	(34,100)	7,867	7,867	Detroit			
Harper Woods	Wayne	(20,000)	5,318	5,318	Detroit			
Hazel Park	Oakland	(25,800)	7,526	7,526	Detroit via Royal Oak Twp.	-	-	
Huntington Woods	Oakland	(8,700)	2,413	2,413	S.E.O.W.A.	-	-	-
Huron Twp.	Wayne	(800)	222	222	Detroit			
Inkster	Wayne	(39,100)	9,959	9,959	Detroit	-	-	
Lathrup Village	Oakland	(3,600)	1,066	1,066	S.E.O.W.A.	-	-	
Lincoln Park	Wayne	(54,000)	14,751	14,751	Detroit	-	-	
Livonia	Wayne	(67,500)	18,125	18,125	Detroit	-	-	
Madison Heights	Oakland	(33,400)	8,975	8,975	Detroit via Royal Oak Twp.			
Melvindale	Wayne	(13,100)	3,648	3,648	Detroit			
Monroe	Monroe	24,500	8,000	8,000	Lake Erie	8.0	3.0	PDc Cal MSv Frs Ng Vs

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TABLE 8-II. MUNICIPAL WATER USE (CONTINUED)

Community	County	Estimated Population Served 1963	Number of Accounts	Number of Meters	Source of Supply	Rated Capacity (MGD)	Average Daily Output (MGD)	Treatment
Nankin Twp.	Wayne	(43,600)	12,310	12,310	Detroit-Flat Rock			
Oak Park	Oakland	(36,700)	9,480	9,480	Detroit			
Pleasant Ridge	Oakland	(3,800)	1,236	1,236	S.E.O.W.A.			
Plymouth Twp.	Wayne	(3,000)	800	800	Detroit			
Pontiac	Oakland	(80,000)	21,088	19,319	From Wells to Detroit in 63		9.145	Wells-DcDhKc
Redford Twp.	Wayne	(71,600)	18,550	18,550	Detroit	-	-	-
River Rouge	Wayne	(18,200)	4,024	4,024	Detroit			
Riverview	Wayne	(6,800)	1,760	1,760	W.C.M.W.A.			
Rockwood	Wayne	(2,200)	-	-	Flat Rock			
Romulus Twp.	Wayne	(9,900)	2,679	2,679	W.C.M.W.A.			
Roseville	Macomb	(50,900)	12,800	12,800	Detroit			
Royal Oak	Oakland	(82,000)	21,720	21,720	Detroit			
S.E.O.W.A.	Oakland	-	-	-	Detroit			

TABLE 8-II. MUNICIPAL WATER USE (CONTINUED)

Community	County	Estimated Population Served 1963	Number of Accounts	Number of Meters	Source of Supply	Rated Capacity (MGD)	Average Daily Output (MGD)	Treatment
Southgate	Wayne	(29,500)	7,489	7,489	Detroit			
Southfield	Oakland	(28,500)	6,716	6,716	S.E.O.W.A.			
St. Clair Shores	Macomb	(76,900)	21,108	21,108	Detroit			
Sterling Twp.	Macomb	(8,100)	2,355	2,355	Detroit			
*Sycamore Beach	Monroe	200	50	x	Well			
Taylor Twp.	Wayne	(50,000)	13,875	13,875	Detroit			
Trenton	Wayne	(19,000)	5,036	5,036	W.C.M.W.A.			
Troy	Oakland	19,058	x	x	Detroit in 1963			
Utica	Macomb	1,400	696	687	Clinton Riv to Detroit '63			
W.C.M.W.A.	Wayne	-	-	-	Detroit			
W.C.M.W.S.	Wayne	-	-	-	Detroit			
Warren	Macomb	(95,300)	27,222	27,222	Detroit			
Wayne	Wayne	(16,400)	4,413	4,413	W.C.M.W.A.			

TABLE 8-II. MUNICIPAL WATER USE (CONTINUED)

Community	County	Estimated Population Served 1963	Number of Accounts	Number of Meters	Source of Supply	Rated Capacity (MGD)	Average Daily Output (MGD)	Treatment
Wyandotte	Wayne	43,900	12,523	12,523		10	6.0	P-DcS Cal MlpVs TcdSc Frs Kc

DOMESTIC WASTE TREATMENT AND DISPOSAL

The major municipal sewage treatment facilities discharging into waters within the Project's study area are tabulated in Table 9-II. Smaller public systems are operated for the express purpose of serving subdivisions or housing areas. The majority of these smaller facilities are located within Grosse Ile Township. Figures 6-II and 7-II represent the location of the municipal water intakes in relation to domestic waste treatment plants and outfalls in both the Detroit River and Lake Erie.

Key to symbols Table 9-II:

B - Sludge beds
- Bo .. Open

C - Settling tanks
- Cm .. Mechanically equipped
- Cp .. Plain, hopper bottom or intermittently drained for cleaning

D - Digester, separate sludge
- Df .. With floating cover
- Dh .. Gas used in heating
- Dr .. Heated
- Ds .. Gas storage in separate holder
- Dt .. Stage digestion

E - Chlorination
- Ec .. With contact tank
- Eg .. By chlorine gas

G - Grit chambers
- Gl .. Without continuous removal mechanism
- Gm .. With continuous removal mechanism

H - Sludge storage tanks

S - Screens
- Sc .. Comminutor
- Sl .. Bar rack, hand cleaned
- Sm .. Mechanically cleaned

V - Mechanical sludge dewatering
- Vv .. Rotary vacuum filter

X - Sludge disposal
- Xn .. incinerated

Z - Sludge conditioning
- Zi .. Chemicals used, iron salt
- Zl .. Chemicals used, lime
- Zy .. Elutriation

DOMESTIC WASTE TREATMENT AND DISPOSAL

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- Gm .. With continuous removal mechanism

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V - Mechanical sludge dewatering
- Vv .. Rotary vacuum filter

X - Sludge disposal
- Xn .. incinerated

Z - Sludge conditioning
- Zi .. Chemicals used, iron salt
- Zl .. Chemicals used, lime
- Zy .. Elutriation

TABLE 9-II. DOMESTIC WASTE TREATMENT AND DISPOSAL

Location of Plant	Population Served	Number of Political Subdivisions Served	Average Flow(MGD)	Treatment* Facilities	Point of Discharge
Belle Isle	450(est.)	1	0.3	Cp X Gh	Detroit River
Detroit	2,782,000	50	548	Sm Gm Eg (Dfrh Zy Zil)	Detroit River
Flat Rock	4,700	1	0.8	Sh Gm Eg X	Huron River
Grosse Ile (Wayne Co.)	700(est.)	1	0.35	Cm Eg C X	Detroit River
Monroe	22,000	1	6.0	Sc Gm Cm Eg C Dfrtsh Bo	Raisin River
Riverview (New)	8,000(est.)	1	1.0(est.)	Cp Egc Gm H Sm X	Detroit River (Trenton Channel)
Rockwood	2,000	1	0.26	Sh Cm Eg X	Huron River
Trenton (Wayne Co.)	20,000	3	2.25	Sm Cm Eg C	Detroit River (Trenton Channel) (Elizabeth Park Canal)
Trenton (New)	20,000	3	2.25(est.)	Cp Eg C Gm H Sch Vv Xn Zcil	Detroit River (Trenton Channel) (Elizabeth Park Canal)
Wyandotte (Wayne Co.)	275,000	10	25	Sc Gm Cm Eg C H Vv Xn Zil	Detroit River (Trenton Channel)

*See Key to Symbols which follows

STORMWATER OVERFLOWS

Table 10-II and Figure 7-II give the location of all the stormwater overflows which may have a significant effect on the Detroit River. In most cases the overflows are located by the names of the streets to which they are nearest. The outfalls are listed from upstream to downstream.

TABLE 10-II. STORMWATER OVERFLOW LOCATIONS

CITY OF DETROIT

Location	No. and Size	Receiving Water
Fox Creek	2 - 10'0"x10'0"	Fox Creek
	1- 12'0"	
Conners Creek	3 - 18'6"x21'9"	Conners Creek
	3 - 14'0"x14'0"	
Fischer	1 - 13'9"	Detroit River
Iroquois	6 - 4'8"	"
E. Grand Blvd.	1 - 11'0"	"
Helen	1 - 9'0"	"
Mt. Elliott	4 - 5'0"	"
Lieb	2 - 10'0"x10'6"	"
Adair	1 - 5'0"	"
Jos. Campau	3 - 6'0"x8'8"	"
Chene	2 - 3'8"	"
Dubois	2 - 5'0"x4'9"	"
	1 - 4'9"	
St. Aubin	1 - 5'0"	"
Orleans	1 - 3'0"	"
Hastings	1 - 5'0"	"
St. Antoine	1 - 5'0"	"
Beaubien	1 - 3'0"	"
Brush	1 - 2'6"x3'0"	"
Randolph	1 - 8'0"	"
Bates	1 - 13'6"	"
Woodward	2 - 6'8"	"
	1 - 8'0"	
Griswold	1 - 7'0"	"
Cass	2 - 4'0"x5'0"	"
First	2 - 10'0"x10'6"	"
Second	1 - 4'9 1/2"x5'7" arch	"
	1 - 5'0"x5'7" arch	"
Third	3 - 4'0" arches	"
Brooklyn	1 - 2'0"	"
S. of Tenth	2 - 5'0"	"
Twelfth	2 - 4'0"	"
Fourteenth	2 - 4'3"	"
Eighteenth	2 - 5'3"	"
Twenty-first	1 - 4'6"x6'0" oval	"
Twenty-fourth	1 - 8'0"	"
W. Grand Blvd.	1 - 3'0"	"
Swain	1 - 3'0"	"
Scotten	2 - 4'8"	"
McKinstry	2 - 4'6"	"
Summit	3 - 7'6"x8'8"	"
Ferdinand	2 - 4'6"	"
Morrell	4 - 5'0"	"

CITY OF DETROIT--Continued

Location	No. and Size	Receiving Water
Junction	1 - 13'0"	Detroit River
Campbell	1 - 6'6"	"
	1 - 6'2"	"
	1 - 6'3"	"
Dragoon	1 - 10'6"	"
Schroeder	2 - 5'3"	"
	1 - 6'10"	"
Fort Cutoff & Dearborn Ave.	6 - 4'6"x4'0" F. Gates	Rouge River
Flora & Reisener	2 - 1'0" F. Gates	"
Pulaski	1 - 5'0"	"
	1 - 6'6"	"
Dearborn Ave.	1 - 5'9"	"
Gary	2 - 3'0"	"
Anderson	1 - 3'0"	"

CITY OF DEARBORN

Westwood	1 - 2'6"	L. Rouge River
Silvery Lane	1 - 3'0"	"
1000' W. of Telegraph	1 - 8'0"	"
Telegraph	1 - 8'0"	"
	1 - 7'6"	
1000' E. of Telegraph	1 - 1'0"	"
Outer Drive	1 - 4'0"	"
	1 - 10'0"	
Reginald	1 - 9'6"	"
Military	1 - 6'3"	"
Monroe	1 - 2'6"	"
Willoway	1 - 4'6"	"
750' E. of East End of Garrison	1 - 4'9"	"
2000' W. of Southfield Road	1 - 11'6"	Rouge River
2000' E. of Southfield Road	1 - 12'0"	"
2500' E. of Southfield Road	1 - 10'0"x12'9"	"
N. Dearborn Road & Rotunda Drive	1 - 5'0"x10'0"	"
Ford Motor Company	1 - 10'0"x12'6"	"
Boat Slip	1 - 10'0"x11'6"	"
	1 - 10'0"x11'0"	"

CITY OF RIVER ROUGE

Jefferson	1 - 6'0"	Rouge River

CITY OF ECORSE

Southfield	1 - 4'0"	Detroit River

CITIES OF ALLEN PARK AND LINCOLN PARK

Location	No. and Size	Receiving Water
White	1 - 5'6"	Ecorse River
Farnham	1 - 5'6"	"
Near Junction of	2 - 9'0"x9'0"	"
S. Branch	1 - 5'6"	

CITY OF WYANDOTTE

Perry	1 - 3'6"	Detroit River
Superior Blvd.	1 - 3'0"	"
	2 - 4'0"	
Orange	1 - 3'0"	Trenton Channel
Ludington	1 - 3'0"	"

CITY OF RIVERVIEW

Pennsalt Chemical Company property	1 - 4'0"x4'0"	Trenton Channel
Sibley	1 - 3'6"	"

CITY OF TRENTON

Elm	1 - 4'6"	Trenton Channel
Elizabeth	1 - 2'6"	Elizabeth Park Canal
S. of Detroit Edison Co.	Unknown	" " "

SECTION III

POPULATION AND MANUFACTURING TRENDS

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INTRODUCTION

In an urban and highly industrialized region such as the Detroit metropolitan area, lakes and rivers are not only objects of beauty and recreation, but are crucial to maintaining high levels of productivity and prosperity. Vast quantities of water are consumed daily by cities, to wash and nourish their citizens, and by industries, to cool their machines and process their goods. Approximately 3,582,850,000 gallons of water per day are used for industrial purposes alone in the Detroit area. Since industrial and population expansion is almost a sure thing in Detroit, it is also probable that demands for water will increase. Pollution, then, is not only a destruction of natural beauty but an economic debit, for it cuts down the supply of water that is useful. In this section the probability of a need for increased quantities of clean water will be demonstrated, in a general way, by estimates of projected population and manufacturing growth in the Detroit area.

The State of Michigan is part of the large industrial complex of the United States known as the "manufacturing belt". The belt or "strip" comprises portions of the three Middle Atlantic States of New Jersey, New York, and Pennsylvania and of the five East North Central States of Illinois, Indiana, Michigan, Ohio, and Wisconsin. Michigan is particularly closely tied to the group of East North Central States, and a description of manufacturing and population trends on these five states is included here, as a context in which to place the Detroit Project area. For the purposes of this section, "the Project area" includes Macomb, Monroe, Oakland, and Wayne counties. The Detroit Standard Metropolitan Statistical Area (DSMSA) includes only Macomb, Oakland, and Wayne Counties; Monroe County has been added because of its contiguity to Lake Erie.

INDUSTRIAL PRODUCTIVITY

Regional Trends

Table 1-III indicates the trends in value added by total manufacture in the five-state region of Illinois, Indiana, Michigan, Ohio, and Wisconsin.

As a percent of the nation's total, the five-state region declined slightly but steadily from 1939 to 1958. The 1958 five-state total of value added by manufacture as a percent of the nation was about 29 as compared with about 31.4 percent in 1947. From 1958 to 1962 the percentage share of the nation increased slightly again and, of course, actual dollar value greatly and steadily increased since 1939, though at a little less than the national rate.

Project Area Trends

Manufacturing in Michigan and in the Detroit area is characterized by heavy concentration in durable goods production (automobiles, industrial machinery, etc.). When the national economy enters a recession, durable goods always suffer a greater contraction of their market than do nondurable goods. Accordingly Detroit, because of its heavy dependence on such manufacture, experience widespread fluctuations in its local economy.

Manufacturing in the Detroit area is further characterized by heavy concentration in a single industry, namely, motor vehicle production. In recent decades, however, the automobile industry has been responsible for a decreasing proportion of total manufacturing employment in the area, i.e. some diversification of the manufacturing economy is occurring. The future may see industries which are heavy users of water playing a larger role in Detroit's economy. These are: food and foodstuffs processing; paper and allied products manufacturing; chemicals manufacturing; petroleum and coal processing; and primary metals manufacturing. Trends in value added by manufacture for heavy water-using industries are shown in Table 2-III (data for Monroe County were not available and it was not included in the Table).

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Table 2-III indicates that the Detroit SMSA's share of the nation's total held relatively constant from 1947 to 1954, declined sharply from 1954 to 1958, regained a large part of the loss by 1960, and turned downward again in 1962. The large concentration of durable-goods industries in the Detroit area, as mentioned earlier, is the major cause of this wide fluctuation. The primary metals industry, a large water-user, showed a sharp increase in activity between 1938 and 1960.

Table 3-III shows value added for all manufacture in the Project area broken down by county. The trend was down from 1939 to 1947, relatively constant from 1947 to 1958, and down sharply from 1954 to 1958. During 1962, value added by manufacture in the four-county Project area totaled approximately 6.1 billion - almost 4 percent of the nation's total, 51.0 percent of Michigan's total, and 11.6 percent of the five-state total.

Dollar figures indicating value added by total manufacturing (Table 3-III) and by major water-using industries (Table 2-III) were converted to 1960 constant dollars by use of the wholesale price index (1947-49-100). On the basis of 1960 dollars as a measure of industrial activity, all manufacturing output doubled between 1939 and 1960, and output of the major water-using industries increased by eighty percent between 1947 and 1960. The growth rate of all manufacturing in the area from 1939 to 1960 was 3 3/4 percent, annually compounded. The growth rate of the major water-using industries from 1947 to 1960 was 4 3/4 percent annually compounded. Although little room for new industries is available on the Detroit waterfront, there is evidence that future industrial growth will be as great as previously and that means of obtaining necessary water will be found. Using compound growth rates it is anticipated that total manufacturing in the area will double in value added and that major water-using manufacture will increase by 150 percent between 1960 and 1980. (See figure 1-III and Table 8-III).

POPULATION GROWTH

Regional Trends

The total five-state population showed little change from 1940 to 1960 as a percent of the nation's population, but Michigan alone steadily increased its share of the nation's population, from 3.9% to 4.3%. All five states, of course, had actual increases in population.

The trend in total manufacturing employment in the five-state area was greatly similar to that in total manufacturing value added, that is, an increase in percent of the nation from 1939 to 1954, a decline from 1954 to 1958, and recovery thereafter (see Table 4-III).

Project Area Trends

Manufacturing employment in the study area has declined since 1947 both actually and as a percent of the nation. The percentage dropped from 3.7 in 1947 to 2.6 in 1960. This decline is by no means associated with a decline in production, however, for automation in durable goods manufacture has probably accounted for a large part of the drop in employment. (See Table 6-III).

Table 7-III shows an increase in the total population of the Project area from 2.4 million in 1940 to 3 million in 1950 and 3.9 million in 1960. Although slowing down in its growth rate, the Project area grew more rapidly than the national rate throughout the two decades. By 1980 it is projected that the population of the Project area will reach 5.5 million, which would represent an increase of 41.5% since 1960.

Population of the four-county area as of April 1, 1963, is 3,989,000, distributed as follows: Macomb County 473,000; Monroe County 109,000; Oakland County 735,000; Wayne County 2,672,000. The 1980 projections are: Total 5,475,000; Macomb 800,000; Monroe 175,000; Oakland 1,200,000; Wayne 3,300,000.

CONCLUSIONS

1. Between 1960 and 1980 major water-using industries in the four-county Project area expected to increase in value added by manufacture by 150%. While this increase is not directly applicable to increased water use, it is reasonable to assume that demand for industrial water will increase significantly.

2. Between 1960 and 1980 the population of the Project area is expected to increase 40%, from 3.9 million to 5.5 million. This growth should greatly increase the demand for municipal water.

3. The predicted rate of industrial growth is greater than the predicted rate of population increase. Consequently, industrial waste discharges will probably increase more than municipal sewage discharges.

4. Unless effective pollution control is achieved, the increased burden of waste discharges on the Detroit River and adjacent Lake Erie will degrade the water resources of the Detroit area still further. At the same time, increased demand for clean water for all uses - industrial, municipal, and recreational - will accelerate the economic costs of pollution.

TABLE 1-III. VALUE ADDED BY TOTAL MANUFACTURE FOR ILLINOIS, INDIANA, MICHIGAN, OHIO, AND WISCONSIN
1939 - 1962
DOLLAR AMOUNTS IN MILLIONS

State	1939 Value Added	1939 %N	1947 Value Added	1947 %N	1954 Value Added	1954 %N
Illinois	2201.6	8.986	6683.1	8.995	9663.8	8.232
Indiana	970.2	3.960	2970.0	3.997	4632.0	3.945
Michigan	1798.4	7.340	5200.1	6.999	8707.2	7.417
Ohio	2125.5	8.675	6358.0	8.558	10154.4	8.650
Wisconsin	686.6	2.802	2171.8	2.923	3198.2	2.724
Total	7782.3	31.763	23383.0	31.472	36355.6	30.968

State	1958 Value Added	1958 %N	1960 Value Added	1960 %N	1962 Value Added	1962 %N
Illinois	11664.1	8.256	12652.6	7.751	12670.9	7.624
Indiana	5478.1	3.877	6259.8	3.834	7094.0	3.956
Michigan	8363.6	5.920	10864.7	6.656	11969.3	6.675
Ohio	11472.5	8.120	13841.8	8.479	14577.7	8.129
Wisconsin	3959.5	2.802	4680.3	2.867	5100.2	2.844
Total	40937.8	28.975	48299.2	29.587	51412.1	29.228

%N = Percent of Nation

Note: Dollar values have not been adjusted for price change.

Source: 1939 Census of Manufactures; Census of Manufactures, Volume III, Area Statistics, P 148-49 (for 1947 and 1954); 1958 Census of Manufactures, Area Reports for Illinois, Indiana, Michigan, Ohio, and Wisconsin; 1960 Annual Survey of Manufactures, Part 3 - East North Central Area Report. 1962 Annual Survey of Manufactures, Part 3 - East North Central Area Report.

TABLE 2-III. INDUSTRIAL TRENDS OF DETROIT STANDARD METROPOLITAN STATISTICAL AREA, 1947-1962
FOR WATER USING INDUSTRIES (VALUE ADDED BY MANUFACTURE)
DOLLAR AMOUNTS IN MILLIONS

	1947			1954			1958		
	Value Added	%A	%N	Value Added	%A	%N	Value Added	%A	%N
Food and Kindred Products	120.5	5.574	1.434	213.6	7.762	1.857	256.5	5.954	1.465
Paper and Allied Products	23.0	2.964	.789	37.9	3.302	.818	38.6	2.772	.676
Chemicals and Allied Products	123.7	9.079	2.326	219.1	10.124	2.294	240.8	8.741	1.962
Petroleum and Coal Products	35.3	8.194	1.772	27.6	4.439	1.231	29.1	5.499	1.155
Primary Metal Industries	275.3	11.400	4.802	469.5	12.123	4.742	432.8	9.975	3.708
Total	577.8			967.7			997.8		

	1960			1962	
	Value Added	%A	%N	Value Added	%N
Food and Kindred Products	279.9	5.806	1.423	313.4	1.748
Paper and Allied Products	N/A	-	N/A	N/A	-
Chemicals and Allied Products	277.3	8.849	1.928	268.3	1.496
Petroleum and Coal Products	N/A	-	N/A	N/A	-
Primary Metal Industries	673.0	12.501	5.054	711.3	3.967
Total	N/A			N/A	

N/A = Not available.
%A = Percent of five-state area.
%N = Percent of Nation.

Note: Dollar figures have not been adjusted for price changes.

Source: U.S. Census of Manufactures for years shown, except 1960 and 1962, which are from U.S. Annual Survey of Manufactures.

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TABLE 3-III. VALUE ADDED BY MANUFACTURE IN COUNTIES OF THE DETROIT RIVER-LAKE ERIE PROJECT AREA, 1939 - 1962
DOLLAR AMOUNTS IN MILLIONS

County	1939 Value Added	1939 %A	1939 %N	1947 Value Added	1947 %A	1947 %N	1954 Value Added	1954 %A	1954 %N
Macomb	20.0	1.81	.081	106.4	3.60	.142	281.2	5.88	.239
Monroe	13.6	1.23	.055	44.6	1.51	.061	68.0	1.42	.058
Oakland	64.0	5.80	.261	261.5	8.84	.351	532.0	11.14	.453
Wayne	1004.6	91.16	4.100	2544.8	86.05	3.426	3900.0	81.56	3.322
Total	1102.2		4.497	2957.3		3.980	4781.2		4.072

County	1958 Value Added	1958 %A	1958 %N	1960 Value Added	1960 %A	1960 %N	1962 Value Added	1962 %A	1962 %N
Macomb	486.4	11.13	.344	577.3	10.07	.353	655.2	10.80	.365
Monroe	58.1	1.33	.041	67.9	1.19	.041	75.3	1.24	.042
Oakland	538.8	12.33	.382	866.4	15.12	.530	1007.7	16.63	.562
Wayne	3287.2	75.21	2.327	4219.9	73.62	2.585	4320.0	71.31	2.404
Total	4370.5		3.094	5731.5		3.509	6058.2		3.373

%A = Percent of Project area
%N = Percent of Nation

Source: U.S. Census of Manufactures for years shown, except 1960 and 1962, which are from U.S. Annual Survey of Manufactures.

TABLE 4-III. TOTAL MANUFACTURING EMPLOYMENT OF ILLINOIS, INDIANA, MICHIGAN, OHIO, AND WISCONSIN 1939 - 1962

State	1939 Mfg. Empl. (000)	1939 %N	1947 Mfg. Empl. (000)	1947 %N	1954 Mfg. Empl. (000)	1954 %N
Illinois	759.7	7.538	1186.1	7.756	1222.4	7.580
Indiana	340.6	3.378	548.3	3.584	587.3	3.642
Michigan	621.2	6.163	975.5	6.376	1056.5	6.551
Ohio	735.3	7.296	1194.3	7.809	1292.6	8.015
Wisconsin	254.6	2.526	405.9	2.655	439.2	2.737
Total	2711.4	26.901	4310.1	28.180	4598.0	28.525

State	1958 Mfg. Empl. (000)	1958 %N	1960 Mfg. Empl. (000)	1960 %N	1962 Mfg. Empl. (000)	1962 %N
Illinois	1186.8	7.406	1208.8	7.227	1194.1	
Indiana	550.9	3.437	588.0	3.515	596.7	
Michigan	880.4	5.494	964.0	5.763	936.6	
Ohio	1196.1	7.464	1265.6	7.566	1222.6	
Wisconsin	438.6	2.737	465.8	2.784	469.7	
Total	4252.8	26.538	4492.2	26.855	4419.7	

%N = Percent of Nation

Source: 1939 Census of Manufactures; Census of Manufactures, Volume III, Area Statistics, P 48-49 (for 1947 and 1954); 1958 Census of Manufactures, Area Reports for Illinois, Indiana, Michigan, Ohio, and Wisconsin; 1960 Annual Survey of Manufactures, Part 3 - East North Central Area Report. 1962 Annual Survey of Manufactures, Part 3 - East North Central Area Report.

TABLE 5-III. POPULATION OF ILLINOIS, INDIANA, MICHIGAN, OHIO, AND WISCONSIN
1940 - 1960

State	1940 Population (000)	1940 %N	1950 Population (000)	1950 %N	1960 Population (000)	1960 %N
Illinois	7897.2	5.977	8712.2	5.743	10081.2	5.621
Indiana	3427.8	2.594	3934.2	2.593	4662.5	2.600
Michigan	5256.1	3.978	6371.8	4.200	7823.2	4.362
Ohio	6907.6	5.228	7946.6	5.239	9706.4	5.411
Wisconsin	3137.6	2.375	3434.6	2.264	3951.8	2.203
Total	26626.3	20.152	30399.4	20.039	36225.1	20.197

%N = Percent of Nation's total population.

Source: U.S. Bureau of the Census population reports for years shown.

TABLE 6-III. TOTAL MANUFACTURING EMPLOYMENT IN COUNTIES OF DETROIT RIVER-LAKE ERIE PROJECT AREA, 1939 - 1960

County	1939 Manufacturing Employment Number	1939 %A	1939 %N	1947 Manufacturing Employment Number	1947 %A	1947 %N	1954 Manufacturing Employment Number	1954 %A	1954 %N
Macomb	4512	1.34	.044	14843	2.63	.096	35120	6.42	.217
Monroe	4244	1.26	.041	6820	1.22	.044	8655	1.59	.053
Oakland	16133	4.80	.158	44566	7.90	.291	57624	10.54	.357
Wayne	311332	92.60	3.085	497832	88.25	3.257	310756	75.57	1.939
Total	336221		3.328	564061		3.688	412155		2.566

County	1958 Manufacturing Employment Number	1958 %A	1958 %N	1960 Manufacturing Employment Number	1960 %A	1960 %N
Macomb	46757	11.37	.292	47570	10.77	.284
Monroe	6150	1.50	.038	5864	1.33	.035
Oakland	47522	11.56	.296	55959	12.67	.334
Wayne	310756	75.57	1.939	332433	75.23	1.987
	411185		2.565	441826		2.640

%A = Percent of Project area
%N = Percent of Nation

Source: U.S. Census of Manufactures for years shown, except 1960, which is from U.S. Annual Survey of Manufactures.

TABLE 7-III. POPULATION OF COUNTIES OF DETROIT RIVER-LAKE ERIE PROJECT AREA, 1910, 1940, 1950, 1960, 1980
(WITH PERCENT INCREASE FROM PRECEDING DECADE)

County	Persons Per Sq. Mile, 1960	1910 Total	1910 %A	1940 Total	1940 % Incr.	1940 %A	1950 Total	1950 % Incr.	1950 %A
Macomb	843.7	32,606	5.04	107,638	39.5	4.42	184,961	71.8	5.98
Monroe	179.9	32,917	5.09	58,620	11.7	2.41	75,666	29.1	2.45
Oakland	787.1	49,576	7.67	254,068	20.3	10.43	396,001	55.9	12.81
Wayne	4,392.6	531,591	82.20	2,015,623	6.7	82.74	2,435,235	20.8	78.76
Total		646,690		2,435,949			3,091,863		

County	1960 Total	1960 % Incr.	1960 %A	1980 Total	1980 % Incr.(1)	1980 %A
Macomb	405,804	119.4	10.50	800,000	48.61	14.61
Monroe	101,120	33.6	2.62	175,000	36.5	3.21
Oakland	690,529	74.3	17.87	1,200,000	36.9	21.91
Wayne	2,666,297	9.5	69.01	3,300,000	11.9	60.27
Total	3,863,750			5,475,000		

(1) Average percent increase per decade since 1960.

%A = Percent of Project area

Source: Populations for the years 1910 - 1960, from U.S. Department of Commerce, Bureau of the Census; 1980 projections for Macomb, Monroe, Oakland, and Wayne Counties from "1970 and 1980 Population Projections," Detroit Metropolitan Area, Regional Planning Commission, Population and Housing Committee, February 1963.

TABLE 8-III. SUMMARY OF POPULATION AND MANUFACTURING GROWTH TRENDS IN DETROIT RIVER-LAKE ERIE PROJECT AREA

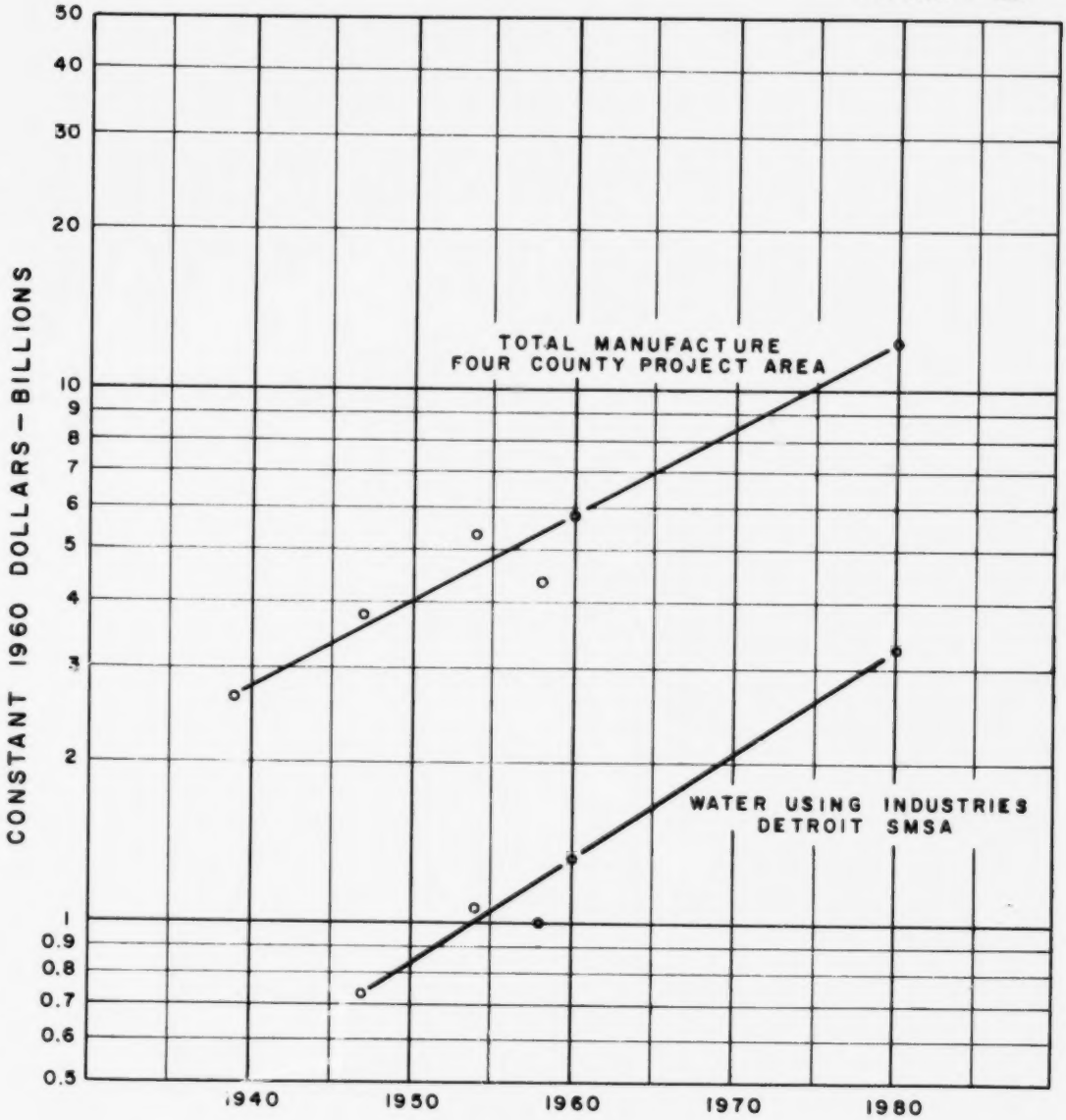
Year	Population
1910	646,690
1940	2,435,849
1950	3,091,863
1960	3,863,750
1980	5,475,000

Year	Value Added by Total Manufacture *
1939	$2,630,000,000
1947	$3,640,000,000
1954	$5,181,000,000
1958	$4,381,000,000
1960	$5,731,000,000
1980	$12,000,000,000

Year	Value Added by Water-Using Industries *
1947	$717,000,000
1954	$1,049,000,000
1958	$1,000,000,000
1960	$1,298,000,000
1980	$3,234,000,000

* In constant 1960 dollars

FIGURE I-III



DETROIT RIVER-LAKE ERIE PROJECT

TRENDS IN VALUE ADDED BY MANUFACTURE IN PROJECT AREA

1939-1980

U.S. DEPARTMENT OF HEALTH, EDUCATION, & WELFARE
PUBLIC HEALTH SERVICE
REGION V GROSSE ILE, MICHIGAN

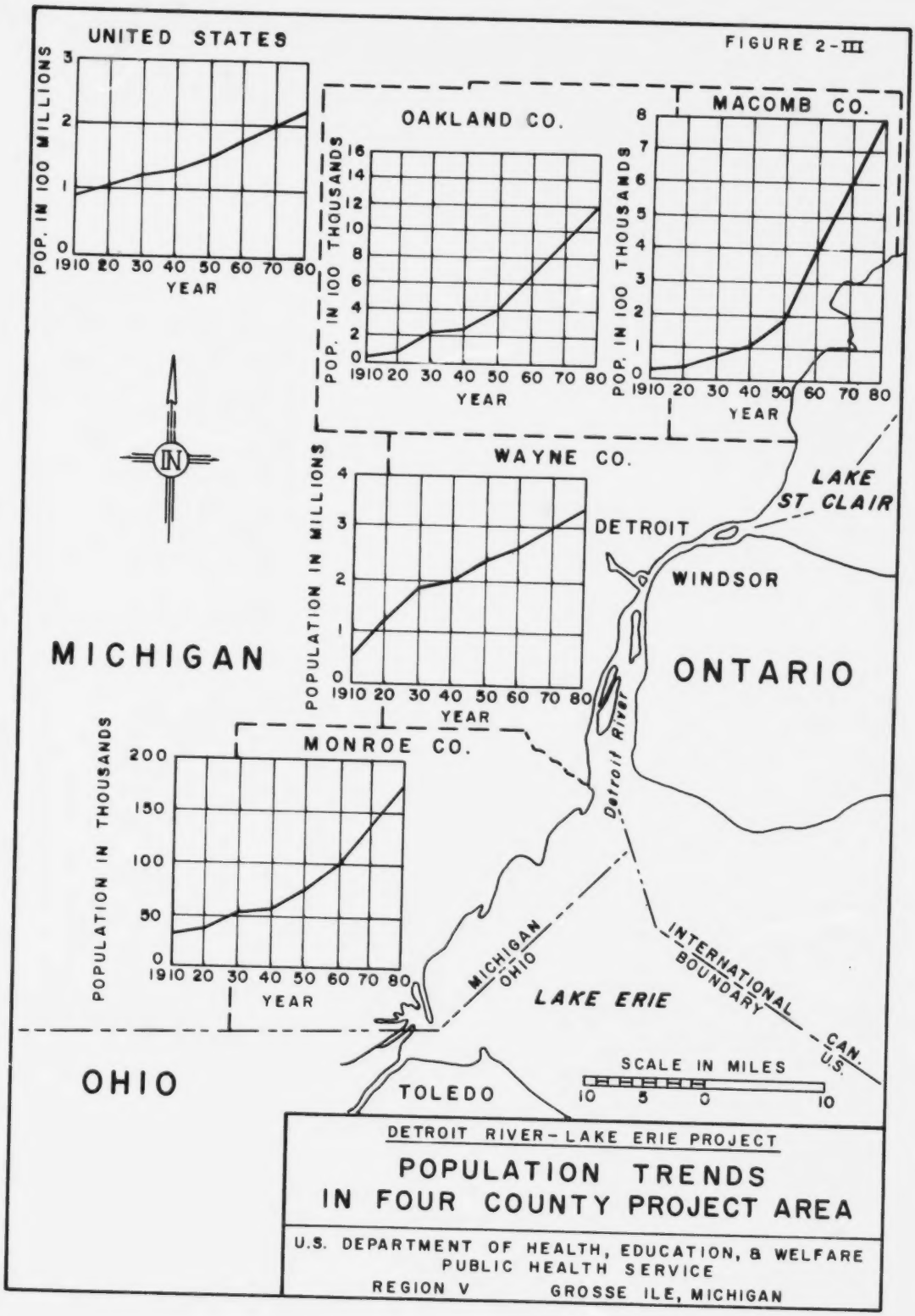


FIGURE 2-III
UNITED STATES
POP. IN 100 MILLIONS
YEAR
OAKLAND CO.
POP. IN 100 THOUSANDS
YEAR
MACOMB CO.
POP. IN 100 THOUSANDS
YEAR
WAYNE CO.
POPULATION IN MILLIONS
YEAR
MONROE CO.
POPULATION IN THOUSANDS
YEAR
IN
MICHIGAN
OHIO
ONTARIO
DETROIT
WINDSOR
LAKE ST CLAIR
Detroit River
MICHIGAN
OHIO
LAKE ERIE
INTERNATIONAL BOUNDARY
CAN.
U.S.
TOLEDO
SCALE IN MILES
10 5 0 10
DETROIT RIVER-LAKE ERIE PROJECT
POPULATION TRENDS
IN FOUR COUNTY PROJECT AREA
U.S. DEPARTMENT OF HEALTH, EDUCATION, & WELFARE
PUBLIC HEALTH SERVICE
REGION V GROSSE ILE, MICHIGAN

SECTION IV

INVESTIGATION OF FEDERAL ACTIVITIES

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INTRODUCTION

Under authority granted by Congress in the Federal Water Pollution Control Act, Section 9, agencies of the Federal Government are requested to cooperate with the Public Health Service in preventing and controlling water pollution from Federal installations, buildings, and properties. It becomes the task of the Public Health Service in an enforcement action to inspect all Federal activities in the study area and to summarize the findings and recommendations in the report to the conferees.

The information included in this section contains the results of the investigations of Federal activities within the study area. Detailed studies were made of three operations within the study area because of the increased possibility that these may have a significant bearing upon the water quality. Also included is a summary of waste disposal practices of other Federal installations located on the study waters.

NAVAL AIR STATION, GROSSE ILE, MICHIGAN

The U.S. Naval Air Station at Grosse Ile is located at the southern end of Grosse Ile Township. This station, which is comprised of approximately 600 acres, functions now as a "Weekend Warrior" center for men from five surrounding states. These men are part of twenty-five squadrons. The base has all of the facilities normally found in any municipality, such as, cafeterias, housing, repair shops, recreation facilities, and other like items. Because of this, the station is quite comparable to a small city during parts of the day and days of the week.

The Naval Air Station, being a reserve training base, undergoes great fluctuations in population from day to day. The normal work week on the station is from Wednesday through Sunday contrasted with Monday through Friday for a normal community. The population on Saturday and Sunday is the largest and changes every weekend because of the different squadrons being trained.

Two significant waste sources originate from the daily routines of the base personnel. One is the domestic wastes which are discharged through an Imhoff tank and the other is the washings from the cleaning of aircraft. The treated wastes from the base sewerage facilities and the untreated wastes from aircraft washing operations are discharged into Frenchman Creek, an embayed tributary to the Detroit River. The net flow of this receiving stream is virtually zero. Its only movement of water is caused by the rising and falling of Lake Erie. Water uses observed on the stream, which is less than two miles long, were recreation and boating with one yacht club being present; esthetic enjoyment; and waste disposal from the aircraft washings, sewage treatment plant effluent, stormwater discharge; and numerous septic tank-tile field drains.

Surveys were performed on these two major waste sources by Project personnel. The treatment plant was studied from January 22 through February 12, 1963, and the washing operation during the period September 6 through September 22, 1963.

Since these surveys were conducted, it has been learned that the U.S. Department of Defense has declared that the station will be closed and all operations transferred to Selfridge Air Force Base by September 1, 1967. The edict came during the month of April 1964, and stated that effective immediately operations would be gradually phased out so that the transfer would be complete by September 1967. Furthermore, all plans for long range improvements and repairs of existing facilities would be re-evaluated based on the recent declaration. This decision unquestionably affected the conclusions and recommendations the Public Health Service would make regarding future sewerage and sewage treatment needs.

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The township of Grosse Ile is, at this time, preparing to construct an island-wide sewerage facility consisting of a separate sanitary collection system and sewage treatment plant. Any future development of the property at the Naval Air Station, whether it be for Federal purposes or otherwise, should seriously consider tieing into the proposed sewerage system of the island.

Sewerage and Sewage Treatment Facilities

The station has a separate storm sewer system covering most of the area and a sanitary system of the combined type. The stormwater entering the sanitary sewers is, however, a small percentage of the total rainfall.

The stormwater system empties into Frenchman Creek through outfalls lying 1,200 feet and 2,500 feet south of Groh Road (the main thoroughfare through the base) as well as at the same point that the sewage plant effluent enters the creek. The sanitary sewage enters the station sewage treatment plant through two principal lines of 15 and 24 inch diameter.

There are four septic tank systems located on the base, two of which are in use. One tank, which actually under strict definition is a cesspool, serves a water closet at the boat house while the other is in the middle of the landing field south of the aircraft parking ramp.

The sewage from the station is subjected to primary treatment in an Imhoff Tank built during World War II to serve a design population of about 5,000. The original plans specified secondary sewage treatment by means of two standard rate trickling filters used in conjunction with the Imhoff Tank. The trickling filters were never constructed so the plant, at this time, has only the Imhoff Tank, chlorination during the recreation season, and sludge drying beds.

During the survey period, the population served by the treatment plant averaged 988 and varied from a low of 512 on a Monday to a high of 1,814 on a Saturday.

The outfall line from the plant is approximately 3,000 feet of 24-inch pipe which runs parallel to the west runway of the airfield and then to a headwall on Frenchman Creek.

The sludge from the Imhoff Tank is hydraulically forced from the tank twice a year and placed upon sludge drying beds south of the plant. Ultimate disposal of the bed is by burial.

The plant has no method of measuring the flow either into or from the plant, and because of this, no operating records are kept, with the exception of a maintenance log.

The plant also has no facilities for analyses other than residual chlorine; however, during the chlorination season samples are sent to the Michigan Department of Health for bacterial analyses.

Flow Measurements

To measure the incoming sewage, it was necessary to divert all sewage over a sharp crested V-notch weir into the channel containing the plant comminutor. The liquid level in the crested stilling basin behind the weir was measured and recorded by means of a portable vertical drum-type liquid level recorder.

Automatic flow measurement began on January 22 and continued until February 15. The period of low flow was during the dormant hours from 2400 to 0600. The peak hours, as expected, were in the morning, with a declining trend generally exhibited from 1200 to 2400. The maximum flow was obtained on Saturday, January 26, when 260,000 gallons

of sewage passed through the plant, and the minimum occurred on January 31 and 135,000 gallons were treated.

The detention time of the sewage in the Imhoff Tank was calculated to determine the limits defined by the maximum and minimum instantaneous flows. Under the assumption that the entire sludge compartment was filled and no short circuiting occurred, a minimum detention time of 2 hours and 8 minutes was calculated with the maximum flow of 315 gallons per minute; a detention time of 10 hours was obtained with the minimum flow of 65 gallons per minute.

The surface loading rate was determined under varying flow conditions to show the range of loadings that the plant experiences. It was learned that, under the conditions found during the minimum day of recorded flow within the study period, the tank was loaded at the low rate of 147 gallons per square foot per day (gsfd), whereas, when the flow figures for the maximum day's flow were used, the loading was 273 gsfd. The condition of having the highest recorded instantaneous flow continue throughout the day was calculated and it was learned that the loading would then be only 495 gsfd; all of these values are well under the recommended surface loading of 600 gsfd, indicating the underloaded condition of this plant.

Sampling Procedure

All samples collected during the test period were taken at intervals throughout the day and night and then composited on a basis proportional to the flow at the time the sample was taken. The influent samples were taken as the sewage flowed over the weir, while all effluent samples were collected from a manhole in the outfall sewer just outside of the plant. On some occasions, samples were collected from the interceptor sewers, outfall, and downstream from the outfall pool.

All collected samples were iced down until composited to limit any bacterial action.

Laboratory Determinations

The summary results of the chemical analyses of samples collected are shown in Table 1-IV.

TABLE 1-IV. SUMMARY RESULTS OF LABORATORY ANALYSES - SEWAGE TREATMENT PLANT-GROSSE ILE NAVAL AIR STATION

		Influent			Effluent		
		Maximum	Minimum	Mean	Maximum	Minimum	Mean
pH		7.7	6.8	7.4	8.1	7.3	7.5
Susp. Solids	mg/l	108	14	59	51	21	31
Total Solids	mg/l	730	440	574	670	520	555
Cond.	μmhos	330	155	242	285	170	235
Alkalinity	mg/l	197	146	174	210	176	188
Chlorides	mg/l	146	28	52	100	23	55
Phenols	ug/l	232	16	78	81	19	49
BOD	mg/l	192	31	94	97	37	56
		Value			Value		
Total Coliform/100 ml		5,100,000			7,100,000		
Fecal Coliform/100 ml		-			6,400,000		
Fecal Streptococcus/100 ml		82,000			71,000		
		119					

The results of the chemical analyses of the sewage, for the most part, indicate that the influent sewage is of weak strength. This is indicated by the analyses of total and suspended solids, BOD, and chlorides.

The plant efficiency indicated a BOD removal of 40 percent and a suspended solids reduction of 47 percent. The removals are somewhat indicative of Imhoff Tank treatment. The removals on individual days, however, are variable in several of the analyses.

Biological Investigation

The biological investigation of the station's outfall pool and receiving waters was performed on February 5, 1963.

In general, it was observed that below the outfall, whitish-gray strands of "sewage fungus" covered the rocks and twigs forming "streamers" in the current. In spots the stream bed was blanketed with felt-like brownish mats of this material. A definite putrescent-type odor, primarily hydrogen sulfide, was observed near the outfall; however, bottled samples of the water a short distance downstream also emitted a strong hydrogen sulfide odor immediately after collection.

The findings indicate that Frenchman Creek is in a septic condition at least from shortly above the station outfall to well below this point. The dense population of ciliate protozoans, restricted almost to a single species; the heavy incidence of Sphaerotilus, Beggiatoa, and other sewage bacteria; the prevalence of fungi coupled with the absence of plankton and all invertebrates, with the exception of tubificid worms and nematodes, leads to the conclusion that the stream is grossly polluted. Only those organisms are present which can tolerate heavy organic pollution and low oxygen potentials. This short stream provides only one zone of existence - the polysaprobic. Such chemical and microbiological data available support the conclusion that the stream is too polluted, not long enough, and lacking a positive movement of water toward its mouth to provide a transition to a mesosaprobic environment.

Conclusions

1. Frenchman Creek, the receiving stream for the effluent from this plant, is grossly polluted.
2. This pollution is primarily caused by wastes originating on the Grosse Ile Naval Air Station.
3. Inadequate waste treatment facilities at the boat dock cause a hazardous situation to water users in this immediate vicinity.
4. Numerous homes, boat wells, and a yacht club have been built along the polluted Frenchman Creek since the construction of the sewage treatment plant.
5. Bacterial concentrations in the effluent from the sewage treatment plant are excessively high, representing a health hazard to those using the water in Frenchman Creek.
6. The results of data collected during this survey indicate plant performance indicative of an Imhoff tank receiving weak sewage, although operation is not as uniform or consistent as desired.

Recommendations

In order to achieve more uniform and consistently satisfactory results from this installation, the following are recommended:

1. Scrape sloping sides of sedimentation chamber daily to keep divisional slots between this chamber and digestion chambers open.

2. Reverse the direction of sewage flow every two weeks to distribute the sludge load in the digestion chamber as evenly as possible.

3. Break up the scum in gas vents by soaking it semi-weekly, or more frequently with water under pressure.

4. Make monthly observations of sludge level at three or more points in the digestion compartment. Maintain at least 18 inches between the top of sludge layer in digestion chamber and the bottom of the divisional slot.

5. Withdraw sludge more frequently and in smaller quantities in the warmer months rather than at longer intervals in large quantities.

6. Maintain a better operating record which would include the following items:

a. Settleable solids in raw sewage and tank effluent (daily).

b. Dates and conditions of skimming and cleaning the flowing-through compartment, removing scum, cleaning of slots, and reversal of influent.

c. Dates of sludge removal, and volume (approximate cubic feet) of sludge removed.

d. Depth of sludge.

e. pH of sludge (at least monthly).

f. Chlorination records.

g. Total coliform concentrations in effluent.

7. During the entire year, very precise and strict control be exercised over the plant effluent by maintaining continuous chlorination of the treated wastes so that the geometric mean of the effluent coliform densities does not exceed 2,400 organisms per 100 ml.

8. Replacement of the outmoded septic tank installation at the boat dock with a treatment unit of the "Aerobic Digestion" design, manufactured for individual householders. A 1,000-gallon unit with overflow to an added 200-gallon chlorination tank with chlorination is recommended.

9. These recommendations are based upon the assumption that the U.S. Naval Air Station at Grosse Ile will be closed on or before September 1, 1967. If this is not the case, one of two alternatives is further recommended.

a. Connection to the municipal sewage collection and treatment system proposed for construction at Grosse Ile in the immediate future.

b. Enlargement of the present naval facilities to include secondary treatment as proposed in the original plans.

AIRCRAFT WASHING OPERATIONS, NAVAL AIR STATION

Each of 41 aircraft assigned to the station is washed, including the engines, once every 2 weeks using two different detergents - Keolite and Turco. Each month 825 gallons of Keolite and 200 gallons of Turco are used. The chemical constituents in the detergents are not known. Usually, washing operations last approximately 3 hours per day. As another possible source of pollution, the hangar decks are also washed approximately every 2 weeks. Water for aircraft and hangar deck washing is supplied from the City of Detroit water system. Waste engine oil from the aircraft is disposed in a dumping ground located adjacent to the east runway. The waste oil is then used to control dust on the road to the boat house.

Laboratory Determinations

The results of the laboratory analyses of samples collected are shown on Table 2-IV.

TABLE 2-IV. RESULTS OF LABORATORY ANALYSES - AIRCRAFT WASHING WASTES GROSSE ILE NAVAL AIR STATION

Date 1963	Time	Temp.	pH	Phenol µg/l	Alk. mg/l	Cl. mg/l	Susp. Sol. mg/l	Total Sol. mg/l	Oil & Grease mg/l	Cond. µmhos	Coli. MF/100ml
9/9	10	19.0									30,000
9/10	9	19.0	8.1	2	214	57	2		7	656	L100,000
9/11	9	19.5	8.0						1	900	13,000
9/11	13	20.0	8.0						0		900
9/22	16			4			20	840	195		6,000
Average			8.0	3	214	57	11	840	51	778	30,000

Oil - based upon recommended design flow of 35,000 gpd.

$$.035 \text{ mgd.} \times 8.34 \frac{\text{lbs}}{\text{gal}} \times 51 \text{ mg/l} = \text{average daily discharge of oil}$$
$$= 14.9 \text{ lbs. of oil/day}$$

Flow Measurements and Sampling Procedures

The wastes from aircraft washing operations drain to Frenchman Creek through a 36" storm sewer approximately 1,200 feet south of Groh Road.

The 36" drain to Frenchman Creek was gaged continuously for the period from September 6 to September 11, 1963, using a 90° V-notch weir and a L&S Type F water level recorder. Flow volumes are recorded in Table 3-IV.

TABLE 3-IV. FLOW MEASUREMENTS - AIRCRAFT WASTES GROSSE ILE NAVAL AIR STATION

Date 1963	Average Daily Discharge (gpd)	Discharge Rate During Hours of Aircraft Washing Operations (gpd)
9/6	17,900	30,800
9/7	20,300	78,000
9/8	10,500	13,800
9/9	16,400	24,600
9/10	14,900	16,900
9/11	17,100	24,500

Five bacteriological and four chemical grab samples were collected during the period of the survey from the water that passed over the weir.

Observations

1. The 36" drain emptying into Frenchman Creek approximately 2,500 feet south of Groh Road was observed during a heavy rainstorm to determine whether the wastes from aircraft washing could possibly get out through this outfall. It had been learned earlier that this sewer had possibly caved in and was blocked off. It did not contain any rainwater and, as a result, would not contain any wastes from aircraft washings.

2. A heavy scum of oil collected behind the baffle at the flow-measuring station. This was the result of a gradual accumulation of floating oil from aircraft washing.

3. Several times, private citizens living along Frenchman Creek have observed heavy oil slicks over the entire creek. It is believed that this is the result of promiscuous dumping of oil in the drain sewer and not the gradual accumulation from aircraft washing. Nevertheless, at all times, a visible light oil sheen was apparent on the water surface.

Conclusions

1. The waste disposal facilities for engine oil are satisfactory.

2. Closer control should be followed to prevent promiscuous dumping of waste engine oil into sewers.

3. Except for oil, the waste effluent from aircraft washing operations appear to be of satisfactory quality to protect present water uses in Frenchman Creek. The bacteria concentrations are no more than would be expected from ordinary land drainage.

4. The 36" drain located 1,400 feet downstream from the drain under study appears to be abandoned and blocked off, thus preventing any aircraft washings from reaching Frenchman Creek through this outlet.

5. At first glance, the washings did not appear to contain much oil. However, a considerable amount of oil did accumulate behind the baffle at the flow-measuring setup and the laboratory analysis also showed oil to be excessive in the waste discharge. Established recommended maximum concentrations of oil in waste effluents should not exceed 15 mg/l.[1] The average effluent concentration of oil from the plane washing operations is 51 mg/l. The discharge of 14.9 lbs. of oil per day to the creek imparted a definite visible sheen of oil on the water surface discoloring and coating the hulls of boats moored in the area.

Recommendations

Untreated wastes from aircraft washing operations should not be admitted to domestic sewage treatment plants;[2] therefore, it is recommended that treatment be provided to prevent damage to present water uses in Frenchman Creek from oil wastes.

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[1] "Report of the International Joint Commission United States and Canada on the Pollution of Boundary Waters." Washington-Ottawa, page 18, 1951.

[2] "Disposal of Airplane Wash Waters." United States Department of Health, Education, and Welfare, Public Health Service, Robert A. Taft, Sanitary Engineering Center, Cincinnati, Ohio, December 1955.

An oil separator should be installed similar in design to that recommended by the American Petroleum Institute.[3] This treatment device provides a mechanism for breaking any emulsions and includes flotation and skimming to adequately dispose of the oil wastes. It is guaranteed by the manufacturer to produce an effluent with not over 15 mg/l of oil and possibly can be obtained as a "Package" plant.

Accordingly, the following preliminary design factors should be considered:

1. A flash mix with the addition of calcium chloride in amounts of approximately 15 lbs. per 1,000 gallons of waste to break the oil-water emulsion.
2. Design flow of 35,000 gpd.
3. Detention time of one hour.
4. Flow-through velocity not to exceed 2 feet per minute.
5. A minimum depth to width ratio of 0.3.

Upon treatment by the gravity oil-water separator, the effluent can then be satisfactorily discharged to Frenchman Creek.

U.S. CORPS OF ENGINEERS MAINTENANCE DREDGING OPERATIONS, ROUGE AND RAISIN RIVERS

Past associations between the Public Health Service and the Corps of Engineers regarding maintenance dredging revealed that the primary responsibility for water pollution control is not with the Corps of Engineers who, in accordance with Congressional instructions, are maintaining a facility of general benefit to the public and of special benefit to the industries using the rivers and harbors for commercial traffic. The primary responsibility lies with the municipalities and industries occupying the banks of the rivers and harbors and discharging inadequately treated sewage and industrial wastes into the streams. Furthermore, the Public Health Service agrees that, in general, the present maintenance dredging operation procedure on the Rouge and Raisin Rivers constitutes an acceptable means of disposing of dredge material. (See U.S. Public Health Service report entitled "Special Studies U.S. Hopper Dredge Savannah Operations, Detroit, River, March 21, 1949.")

On October 3, 1963, two engineers from the Detroit River-Lake Erie Project, Public Health Service, observed dredging operations on the Raisin River aboard the U.S. Army Engineer Hopper Dredge Lyman. On October 24, 1963, dredging operations were observed aboard the U.S. Army Engineer Hopper Dredge Hains operating on the Rouge River. The purpose of the inspections was to ascertain whether the proper precautionary measures are taken by the Corps of Engineers to minimize damage to water quality from dredging operations and to recommend corrective measures if warranted.

The following observations were made during these inspection trips:

Raisin River Dredging Operations - U.S. Army Engineer Hopper Dredge Lyman

During loading operations, a large area of turbid water was observed. Because of the wind and heavy sea conditions, it was impossible to tell which way this material was drifting from the harbor area. On the way to the dumping grounds in Lake Erie, there was no sign of the material leaking from the dredge, and after the material was dumped, no floating debris was seen except garbage that was thrown overboard on the dumping grounds. It has been customary to dump garbage on the designated dumping grounds, but

[3] "Manual on Disposal of Refinery Wastes." American Petroluem Institute, Division of Refining, 1271 Avenue of the Americas, New York, New York, 7th Edition, 1963.

at no other place. Garbage is kept aboard the dredge while in harbor, and while proceeding from harbor to harbor. Also, there were no sanitary facilities aboard the dredge except for the common marine toilet. There was no treatment of waste or chlorination.

During the dredging operations, no problems were observed, except for the turbid water created by the hydraulic pumping of material into the hoppers and the overflow of turbid water from the hoppers while loading operations were underway. Another area of turbid water was observed at the dumping grounds when the material was dumped from the bottom of the dredge, but no turbid water was observed to result from previous operations on the dumping grounds which had taken place about one hour before.

Rouge River Dredging - U.S. Army Engineer Hopper Dredge Hains

The area immediately surrounding the dredge during loading operations was very turbid due to agitation of the bottom material and overflow from the hoppers. While travelling down the Detroit River, a trail of turbid water was noted behind the ship. No reasonable explanation was given of why this occurred except to say that it could not be helped. It was noted, however, that considerable difficulty is experienced in the dredging of material from the Rouge River due to the characteristics of the sludge. Tire rims, wood pulp, tin cans, bottles, etc., are difficult to pump; thus creating problems with the pumps and valves. No pollution problems were encountered in the piping of the material from the hoppers to the Grassy Island disposal site in the Detroit River. However, this operation should be carefully and continually observed to see that no excessive leaks occur in the connecting joint to the ship or in the pipe to the disposal site.

Waste disposal practices observed aboard ship consisted of the following:

(a) Trash is incinerated on board.
(b) The garbage is macerated in a garbage grinder located in the ship's galley prior to disposal into the Detroit River.
(c) Material that will not go through the garbage grinder and cannot be incinerated, such as tin cans and bottles, is disposed of by hand carrying by the cook's mate to the diked area inside the Grassy Island dumping grounds.

The results of our sampling program and investigations did not disclose any apparent damage to water uses from the present dredging methods. Surveillance activities, to unfold any new developments or to determine with more assurance our present position, will continue.

Recommendations

The recommendations of the Public Health Service for closer control of water quality in maintenance dredging operations are outlined as follows:

1. The hopper dredges discontinue disposing of the ship's trash and garbage at the Raisin River Dumping grounds.
2. Install aboard ship suitable treatment units to adequately dispose of all sanitary wastes including trash, garbage and human excreta.
3. Closer control be exercised to minimize the loss of dredge material from the hoppers while proceeding to the dumping grounds.
4. A vigorous attempt be made by the Corps of Engineers to reduce the amount of dredging with action leading to reduction of discharge of settleable material by increasing the charges to polluters for removing the material commensurate with the damages to water uses incurred. It is believed that it was not the intent of Congress that such dredging operations should provide a method of disposal of solid material deposited by individuals or corporations in navigable streams. It is desirable not only that dredged channels be maintained but that every means possible be taken to keep the cost of such maintenance to a minimum.

To put the recommendations into effect as soon as possible, a visit was made to the office of the District Engineer to discuss the findings of the investigations.

The District Engineer agreed to take steps to see that the recommendations be put into effect. He reiterated that the Corps of Engineers does charge the polluters for removing the material commensurate with the damages to water uses incurred and that the Corps of Engineers does not have any statutory authority to prevent the original discharge of the material to the navigable waterway. He also stressed the responsibility of the Corps of Engineers in enforcing Federal legislation relative to discharge of waste materials from vessels into navigable waters.

WASTE DISPOSAL PRACTICES OF OTHER FEDERAL INSTALLATIONS IN THE STUDY WATERS

The information for this phase of the study is summarized in Table 4-IV.

In order that all Federal installations in the study area be on an equal basis regardless of the degree of pollution occurring from each one, it is recommended that the Coast Guard Station at the Detroit River Light install a macerator-chlorinator type device similar to that placed aboard motor launches and in design to that manufactured by the Carlson Company of Mutuchen, Massachusetts. There remains a possibility, though remote, that bathers, fishermen, or even personnel of the station could come in contact with fecal matter originating from the Lighthouse.

The Federal Government should be expected to lead the way in proper waste disposal practices.

TABLE 4-IV. SEWAGE DISPOSAL PRACTICES AT FEDERAL INSTALLATIONS[1]

Name	City	Department	Domestic Sewage gal/day	% treated	Type of Treatment
Naval Reserve Training Center	Detroit	Navy	9,521	100	Discharge to municipal sewers
Belle Isle Coast Guard Station	Detroit	Treasury	1,610	100	" " " "
Detroit Coast Guard Base	Detroit	Treasury	2,520	100	" " " "
Fort Wayne	Detroit	Army	75,000	100	" " " "
Nike Site 26D	Detroit (Belle Isle)	Army	5,000(est)	100	" " " "
Detroit River Light	Unincorporated	Treasury	350	0	Direct discharge to Lake Erie
U.S. Public Health Service Hospital	Detroit	HEW	42,500	100	Discharge to municipal sewers
Naval Air Station	Grosse Ile	Navy	85,000	100	Imhoff Tank with discharge to surface water and chlorination during summer
			15,000[2]		

1. Information obtained from Volume 23 of the "Waste Water Disposal Practices at Federal Installations." December 31, 1960.
2. Untreated wastes from aircraft washing operations discharged to surface waters.

SECTION V

PRESENTATION OF RESULTS:

DETROIT RIVER

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DESCRIPTION OF WATER QUALITY

Bacteriological

High total coliform densities, especially when accompanied by high fecal coliform concentrations, indicate the presence of human or animal wastes which may contain pathogenic organisms capable of causing enteric diseases in humans. The presence of these organisms above acceptable levels is considered a threat to the health and welfare of those who use this water for domestic water supply and recreation purposes.

At the head of the Detroit River average total coliform densities were approximately the same during wet and dry conditions throughout the range. At all locations from just below Belle Isle to the mouth of the Detroit River average total coliform concentrations near the United States shore during wet conditions were 5 to 10 times higher than corresponding values during dry weather. At some locations the difference between the two values became less pronounced in the middle of the River, and very little difference between wet and dry conditions was noted at locations near the Canadian shore.

Bacteriological densities at the head of the Detroit River do not prohibit any water uses. During dry weather, the Detroit River is of a satisfactory bacteriological quality as far as the mouth of the Rouge River. These judgements are based upon the widely used standard for safe recreation--a maximum of 1,000 organisms per 100 ml--and the IJC objective of 2,400 organisms per 100 ml. During or following rainfall of sufficient intensity to cause overflow of combined sewers, however, the Detroit River below Belle Isle and above the Rouge River is polluted to the extent that it cannot be safely used for recreational purposes. During rainfall periods IJC objectives are regularly exceeded near the United States shore.

Conners Creek, the Rouge River, and the Ecorse River are also polluted by storm-caused overflows from combined sewers to the degree that they should not be used for recreational or domestic water supply purposes.

Below the Rouge River and the outfall from the Detroit Sewage Treatment Plant, pollution, in the United States section of the River (particularly near the United States shore), is constantly such that these waters should not be used for recreational purposes or domestic water supply. The high bacterial levels during wet and dry conditions indicate a serious health hazard to potential users of these waters. This seriously polluted zone extends to the mouth of the River and, under dry conditions, eastward from the United States shore a distance varying from 500 to 10,000 feet. During wet conditions the entire United States portion of the Detroit River below the Rouge River is bacteriologically polluted to the extent of interference with recreational use and domestic water supply. These characterizations are based on geometric mean coliform densities, which exceed IJC objectives and recreational standards, and on high fecal coliform densities which constitute a large percentage of the total count.

Statistical study of the bacteriological data reveals that below the headwaters of the Detroit River two distinct log normal populations exist, one during dry weather and one during or following significant rainfall, and thus coliform densities are described in terms of wet and dry conditions. At the headwaters coliform densities were very low, with little difference between wet or dry. The densities ranged from approximately 100 organisms per 100 ml near the Michigan shore to 15 organisms per 100 ml near the International Boundary. Further downstream at the north end of Belle Isle the coliform densities increased to 260 organisms per 100 ml during dry conditions and 680 per 100 ml during wet conditions. Gradual increase in coliform density during dry weather was noted at downstream stations with values of approximately 500 organisms per 100 ml. Wet weather values of approximately 7,000 organisms per 100 ml were noted at this location.

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Below the Rouge River the average dry weather conditions during the survey approximated 4,000 organisms per 100 ml near the United States shore, while values during wet conditions rose to an average of 81,000 organisms per 100 ml. Further downstream average coliform densities stayed at these high levels.

In the Trenton Channel, lower coliform results were noted along the west shore. At the mouth of the Detroit River, the average total coliform density during dry conditions was 5,900 organisms per 100 ml near the Michigan shore. These results are summarized in Figure 1-V. This figure also shows the consistently lower coliform densities in the middle of the River, with higher values at each shore.

Figure 2-V shows, on a map of the Detroit River, zones of geometric mean total coliform densities during wet conditions as well as location of domestic water intakes, domestic waste outfalls, and combined sewer overflows. Four zones, with limits of less than 1,000; 1,000-2,400; 2,400-5,000; and greater than 5,000 coliform organisms per 100 ml are shown. From the head of the Detroit River to Belle Isle the water is predominatly in the first zone, representing average values less than 1,000 organisms per 100 ml. From Belle Isle to the Rouge River the middle of the River remains in this clean water zone, while both United States and Canadian shores indicate bacterial pollution in all of the remaining zones. Below the Rouge River, almost all the water is greater than 2,400 organisms and most greater than 5,000 organisms per 100 ml.

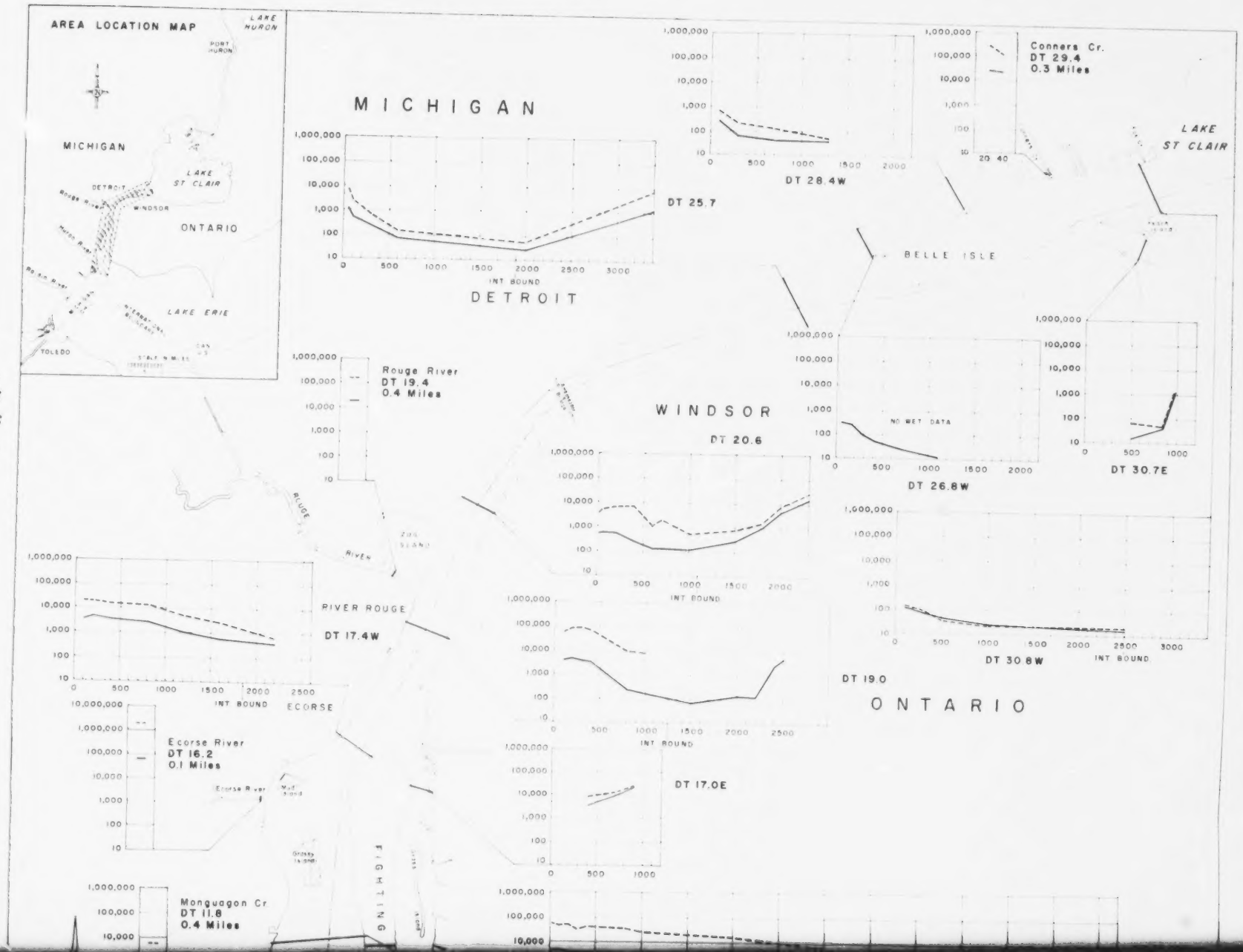
Figure 3-V shows the total coliform densities under dry conditions. The first zone, representing water under 1,000 organisms per 100 ml, extends to the old channel of the Rouge River and then in the middle of the Detroit River to Grosse Ile. From this point downstream the clean water zone is almost entirely in Canadian waters. Downstream from the Rouge River adjacent to the United States shore the values are greater than 2,400 organisms per 100 ml except for a small area near the Grosse Ile toll bridge. From Grosse Ile to the mouth, all United States waters are in the zones representing average values of 2,400-5,000, or greater than 5,000 total coliform organisms per 100 ml under dry or wet conditions.

Fecal coliform and fecal streptococcus determinations were made on routine samples and during intensive surveys on the River. Fecal coliform values during the study ranged from 30 to 90 percent with higher values observed below the Rouge River during wet conditions. This was especially evident during an intensive survey performed in July 1963, when almost 2 inches of rain fell in a 10-day period. At the mouth of the River the fecal coliform densities ranged from 30 to 65 per cent. Fecal streptococci were observed in densities less than either fecal or total coliform organisms. This was especially so during wet conditions. The relationship between total coliform, fecal coliform and fecal streptococcus densities at selected stations during dry and wet conditions is shown in Figures 5-V through 8-V.

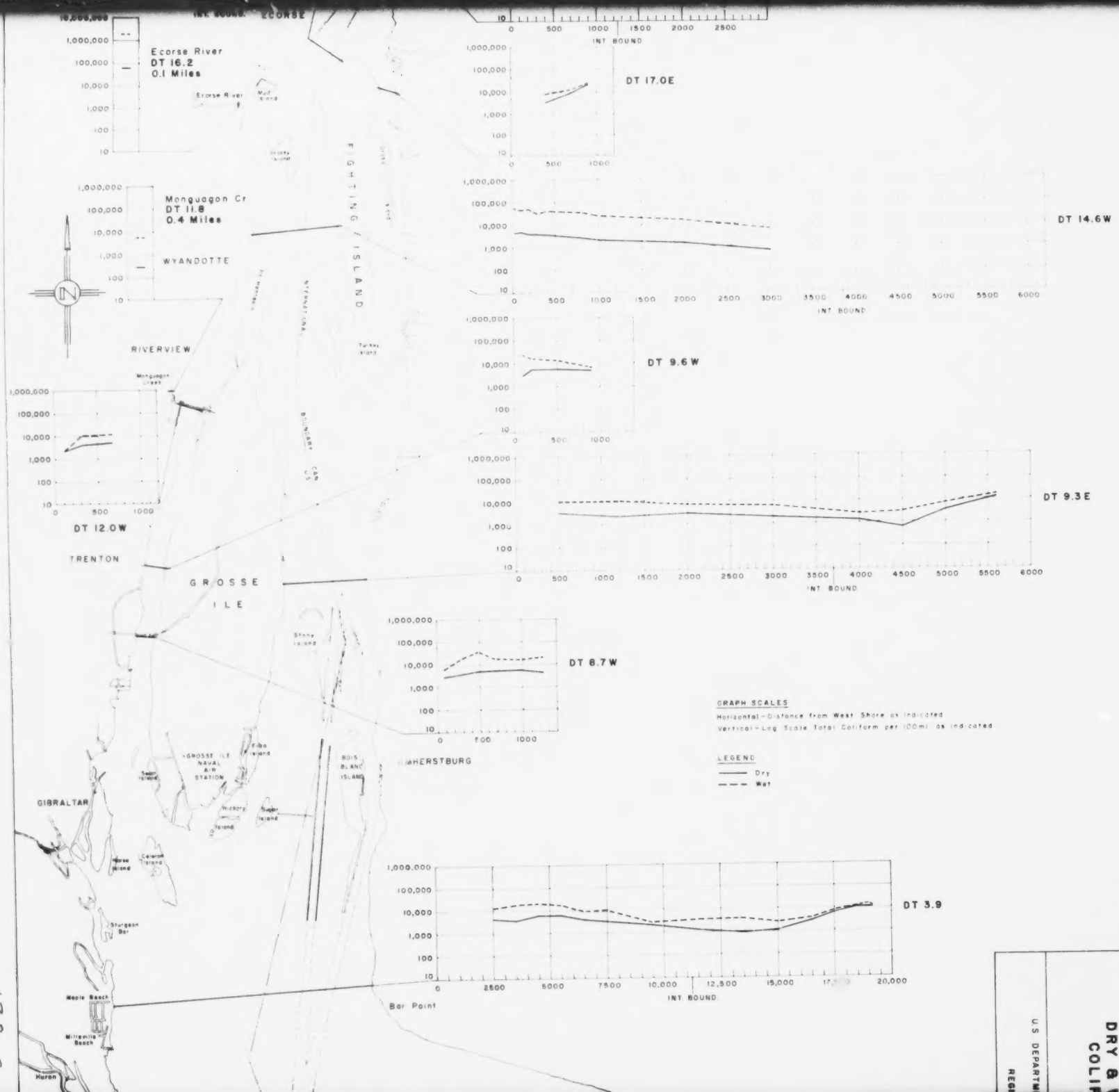
Conners Creek was regularly sampled because of its significance as the receiving stream for combined overflows from the Conner gravity system sewers of the City of Detroit. The geometric mean total coliform densities were 25,000 organisms per 100 ml at the two stations sampled during dry conditions and 260,000 organisms per 100 ml during wet conditions. Fecal coliform values averaged 40 per cent of the total. Fecal streptococcus densities were low at Conners Creek, with average densities of 460 and 500 organisms per 100 ml at the two locations.

The Rouge River, the major tributary of the Detroit River, was observed to have a geometric mean of 18,000 total coliform organisms per 100 ml during dry conditions. During wet conditions the average density was 150,000 organisms per 100 ml. A considerable improvement was noted in 1963 as compared with 1962 sampling results. Average fecal streptococcus densities were 810 organisms per 100 ml. The fecal coliform density at this point was 40 per cent of the total coliform density.

The Ecorse River showed a geometric mean total coliform density of 62,000 organisms per 100 ml during dry conditions, with average values in excess of 1,000,000 total


AREA LOCATION MAP
LAKE HURON
PORT HURON
MICHIGAN
LAKE ST CLAIR
DETROIT
WINDSOR
ONTARIO
LAKE ERIE
TOLEDO
MICHIGAN
DT 25.7
INT BOUND
DETROIT
DT 28.4W
Conners Cr.
DT 29.4
0.3 Miles
LAKE ST CLAIR
BELLE ISLE
Rouge River
DT 19.4
0.4 Miles
WINDSOR
DT 20.6
NO WET DATA
DT 26.8W
DT 30.7E
RIVER ROUGE
DT 17.4W
ECORSE
DT 30.8W
DT 19.0
ONTARIO
Ecorse River
DT 16.2
0.1 Miles
DT 17.0E
Monguagon Cr
DT 11.8
0.4 Miles
FIGHTING

1334



Ecorse River
DT 16.2
0.1 Miles
Ecorse River
Mud Island
Grassy Island
Monguagon Cr
DT 11.8
0.4 Miles
WYANDOTTE
RIVERVIEW
Monguagon Creek
DT 12.0W
TRENTON
GROSSE ILE
FIGHTING ISLAND
INTERNATIONAL BOUNDARY
CAN
U.S.
Turkey Island
Stony Island
GROSSE ILE NAVAL AIR STATION
Fibo Island
Swan Island
Hickory Island
Sugar Island
BOIS BLANC ISLAND
AMHERSTBURG
GIBRALTAR
Horse Island
Celeron Island
Sturgeon Bar
Maple Beach
Milleville Beach
Huron
Bar Point
INT BOUND
DT 17.0E
DT 14.6W
DT 9.6W
DT 9.3E
DT 8.7W
DT 3.9
GRAPH SCALES
Horizontal - Distance from West Shore as indicated
Vertical - Log Scale Total Coliform per 100ml as indicated
LEGEND
Dry
Wet
DETRO
DRY & W
COLIF
U.S. DEPARTM
REG

133 b

133 c

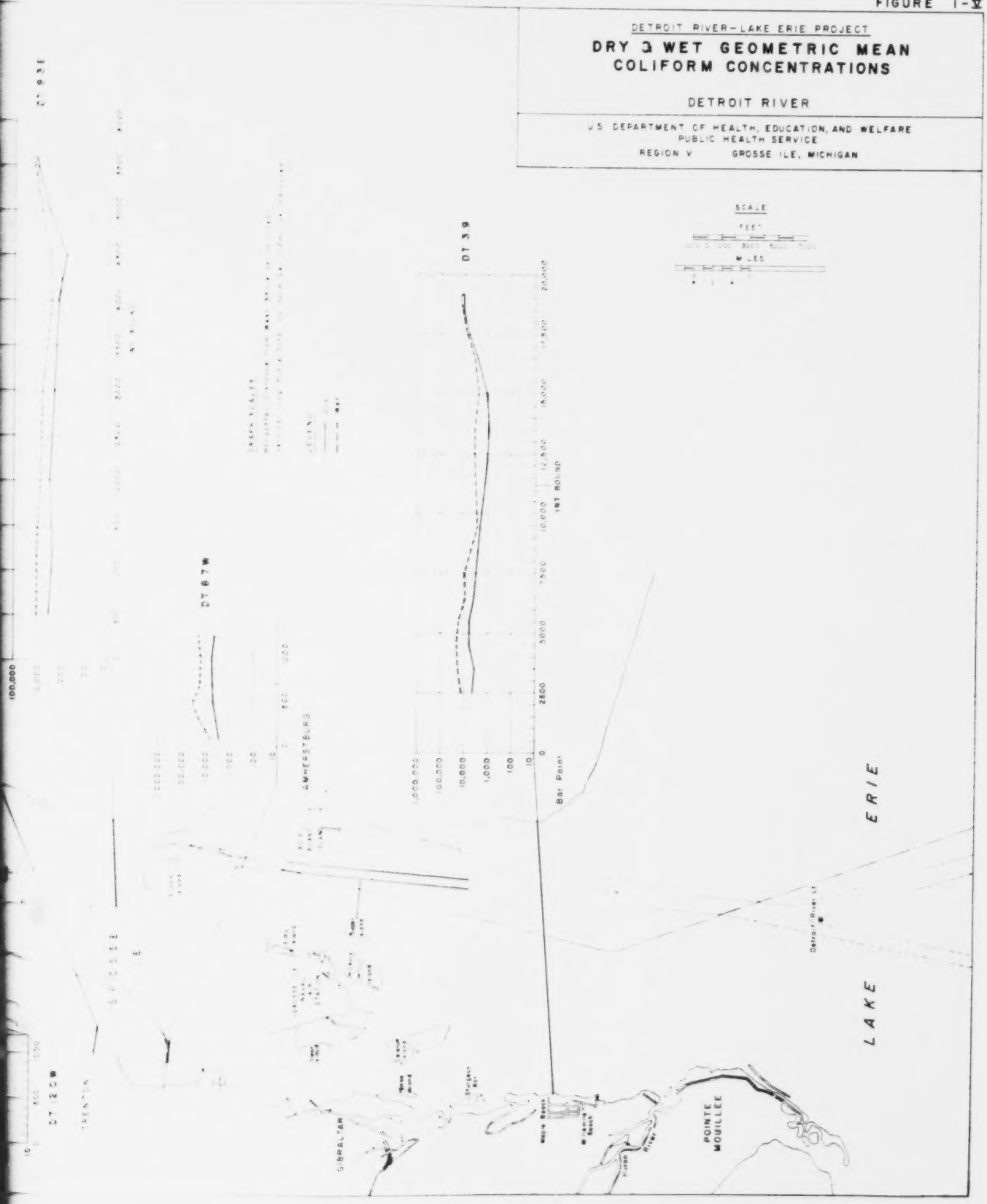
FIGURE I-V

DETROIT RIVER-LAKE ERIE PROJECT

DRY & WET GEOMETRIC MEAN COLIFORM CONCENTRATIONS

DETROIT RIVER

U.S. DEPARTMENT OF HEALTH, EDUCATION, AND WELFARE
PUBLIC HEALTH SERVICE
REGION V GROSSE ILE, MICHIGAN



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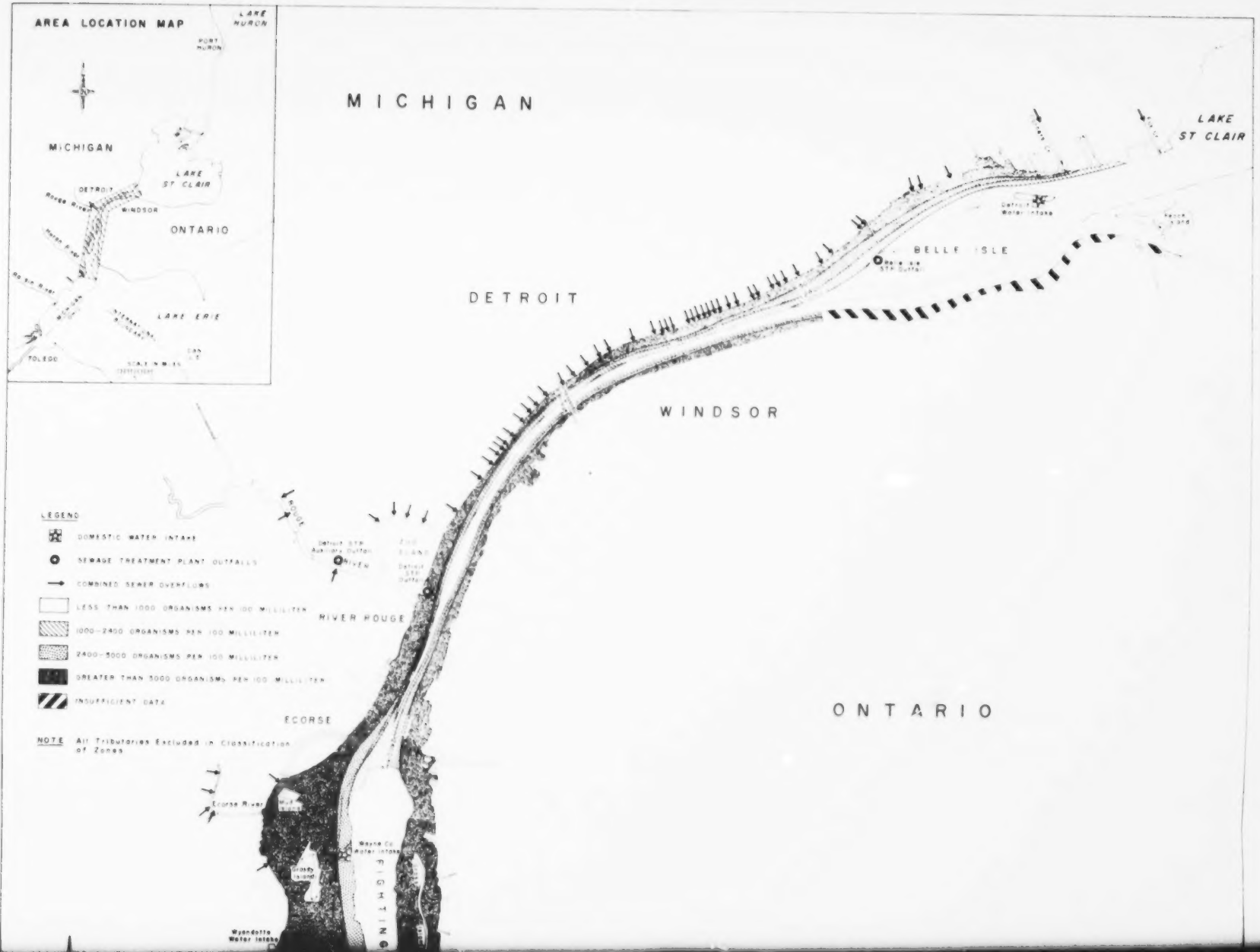
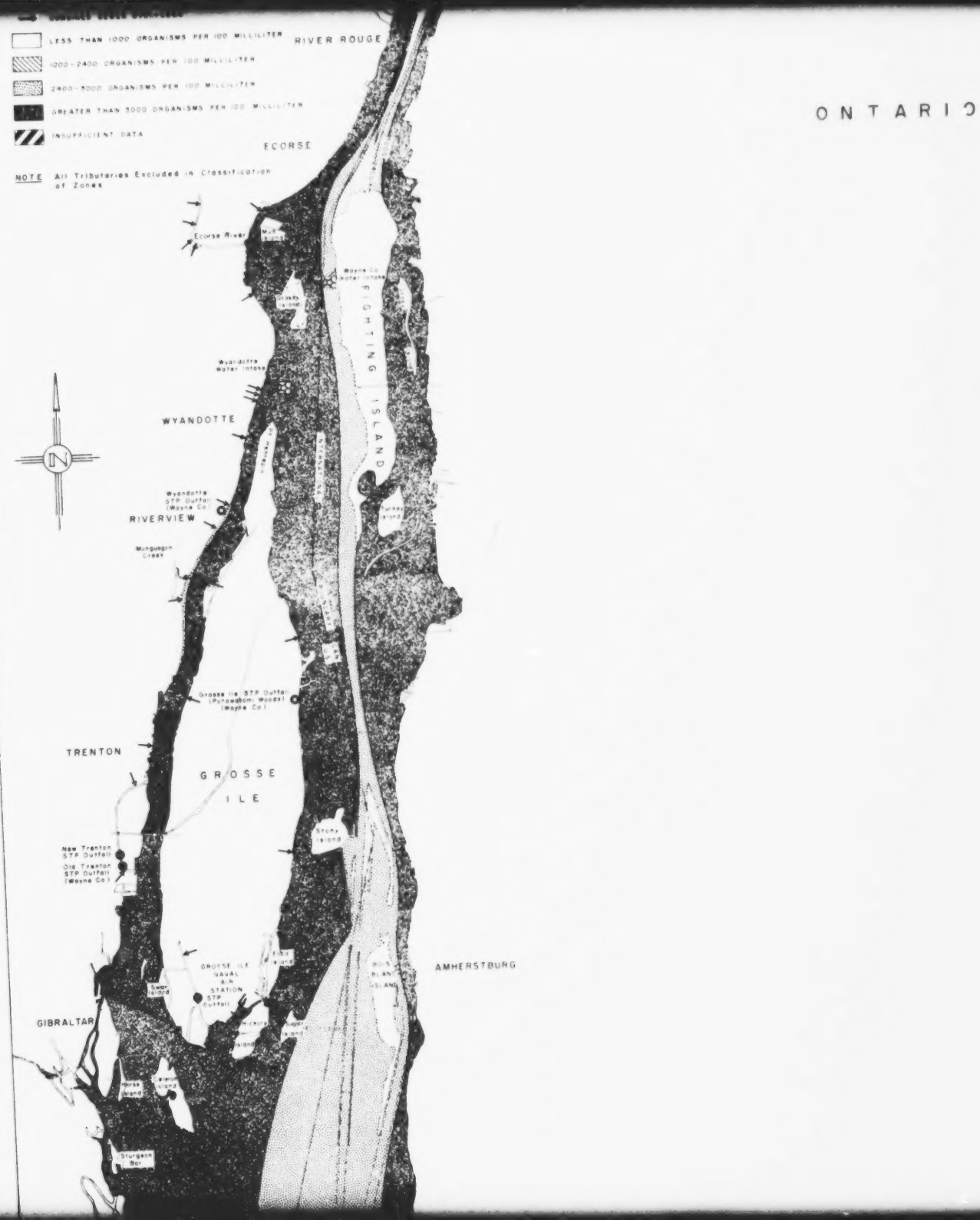

AREA LOCATION MAP
LAKE HURON
PORT HURON
MICHIGAN
LAKE ST CLAIR
DETROIT
WINDSOR
ONTARIO
LAKE ERIE
TOLEDO
MICHIGAN
LAKE ST CLAIR
DETROIT
BELLE ISLE
WINDSOR
ONTARIO
RIVER ROUGE
ECORSE
Ecorse River
Wayne Co. Water Intake
Wyandotte Water Intake
LEGEND
DOMESTIC WATER INTAKE
SEWAGE TREATMENT PLANT OUTFALLS
COMBINED SEWER OVERFLOWS
LESS THAN 1000 ORGANISMS PER 100 MILLILITER
1000-2400 ORGANISMS PER 100 MILLILITER
2400-5000 ORGANISMS PER 100 MILLILITER
GREATER THAN 5000 ORGANISMS PER 100 MILLILITER
INSUFFICIENT DATA
NOTE All Tributaries Excluded in Classification of Zones

133d


LESS THAN 1000 ORGANISMS PER 100 MILLILITER
1000-2400 ORGANISMS PER 100 MILLILITER
2400-5000 ORGANISMS PER 100 MILLILITER
GREATER THAN 5000 ORGANISMS PER 100 MILLILITER
INSUFFICIENT DATA
NOTE All Tributaries Excluded in Classification of Zones
RIVER ROUGE
ECORSE
Ecorse River
Wayne Co Water Intake
FIGHTING ISLAND
Wyandotte Water Intake
WYANDOTTE
Wyandotte STP Outfall (Wayne Co)
RIVERVIEW
Munguagon Creek
Grosse Ile STP Outfall (Potawatomi Woods) (Wayne Co)
TRENTON
GROSSE ILE
Stony Island
New Trenton STP Outfall
Old Trenton STP Outfall (Wayne Co)
GROSSE ILE NAVAL AIR STATION STP Outfall
Swan Island
Elba Island
BOIS BLANC ISLAND
AMHERSTBURG
GIBRALTAR
Horse Island
Celeron Island
Sturgeon Bar
ONTARIO

133 2

FIGURE 2-V

DETROIT RIVER-LAKE ERIE PROJECT

ZONES OF GEOMETRIC MEAN COLIFORM CONCENTRATIONS WET CONDITIONS

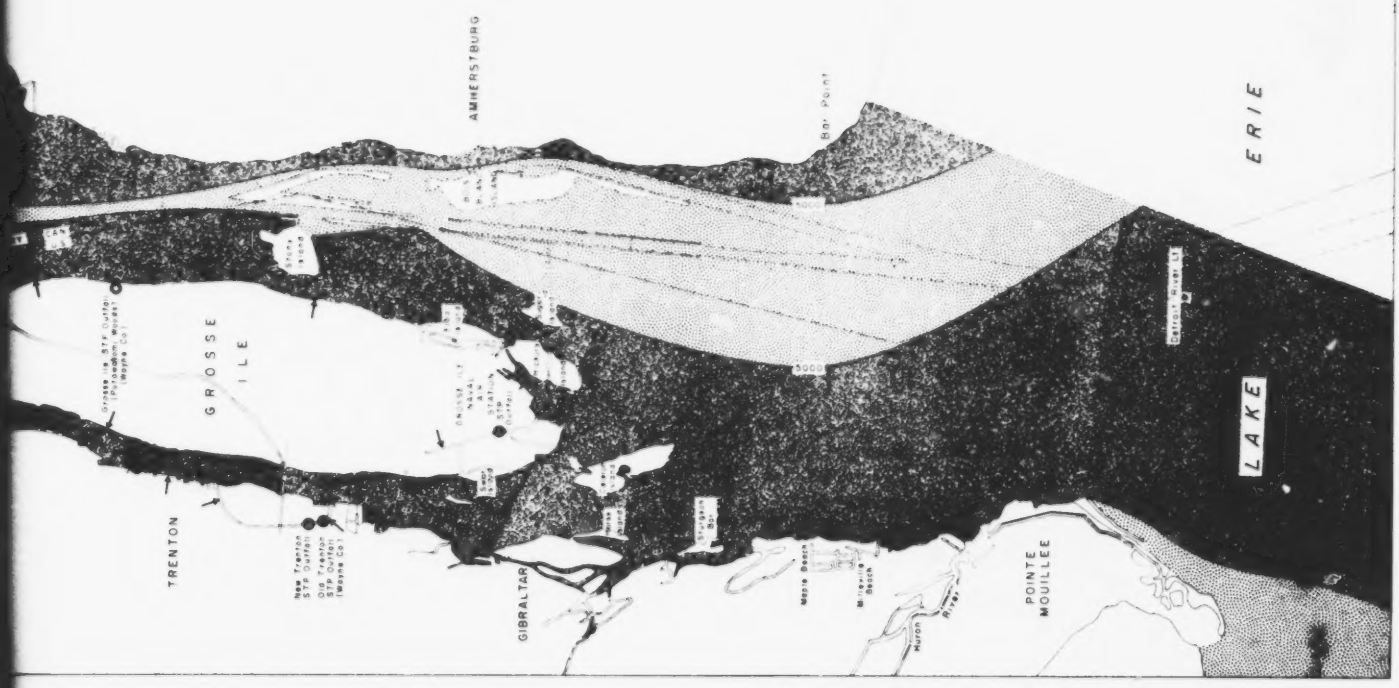
DETROIT RIVER

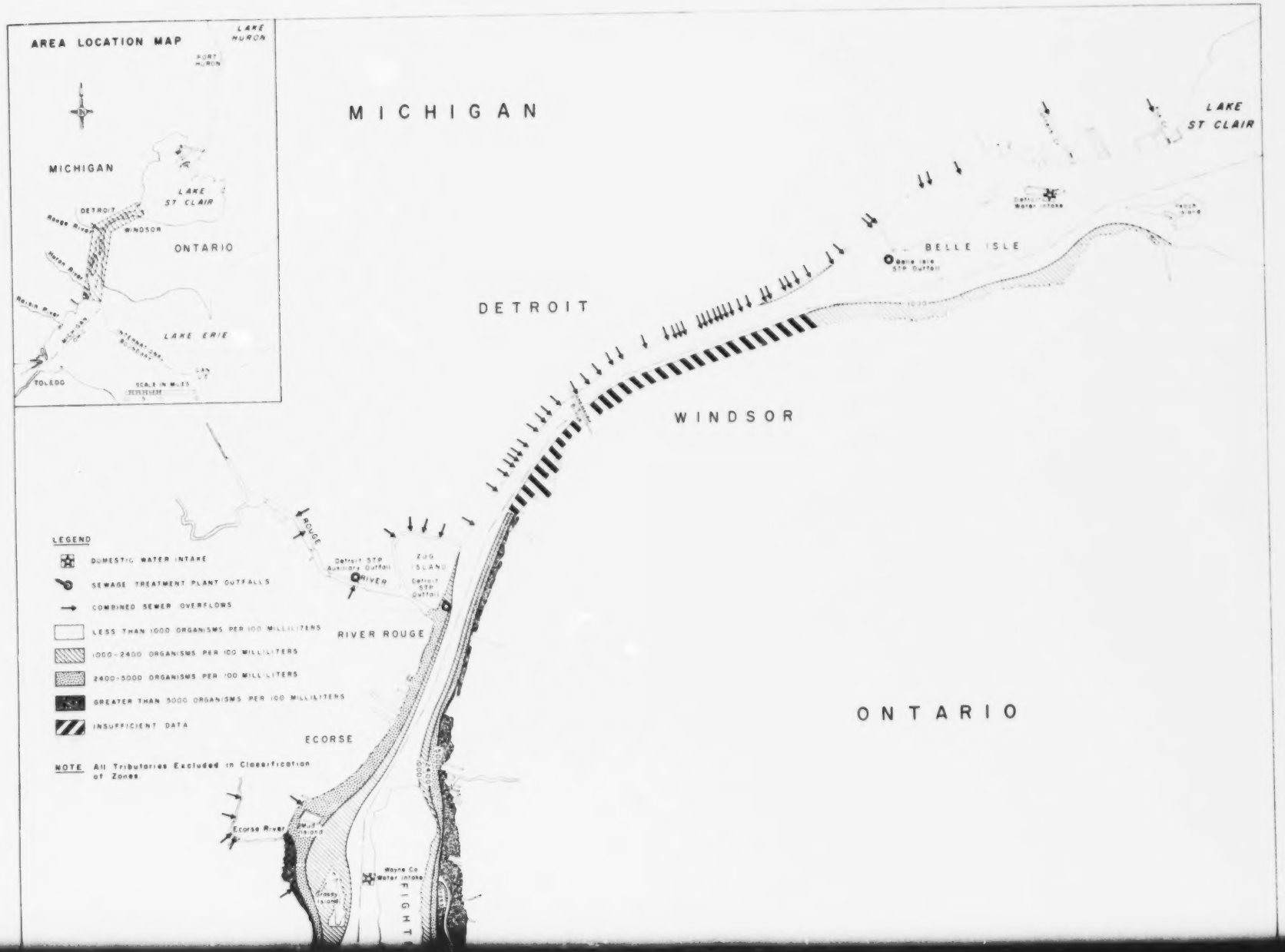
U.S. DEPARTMENT OF HEALTH, EDUCATION, AND WELFARE
PUBLIC HEALTH SERVICE
REGION V GROSSE ILE, MICHIGAN

SCALE

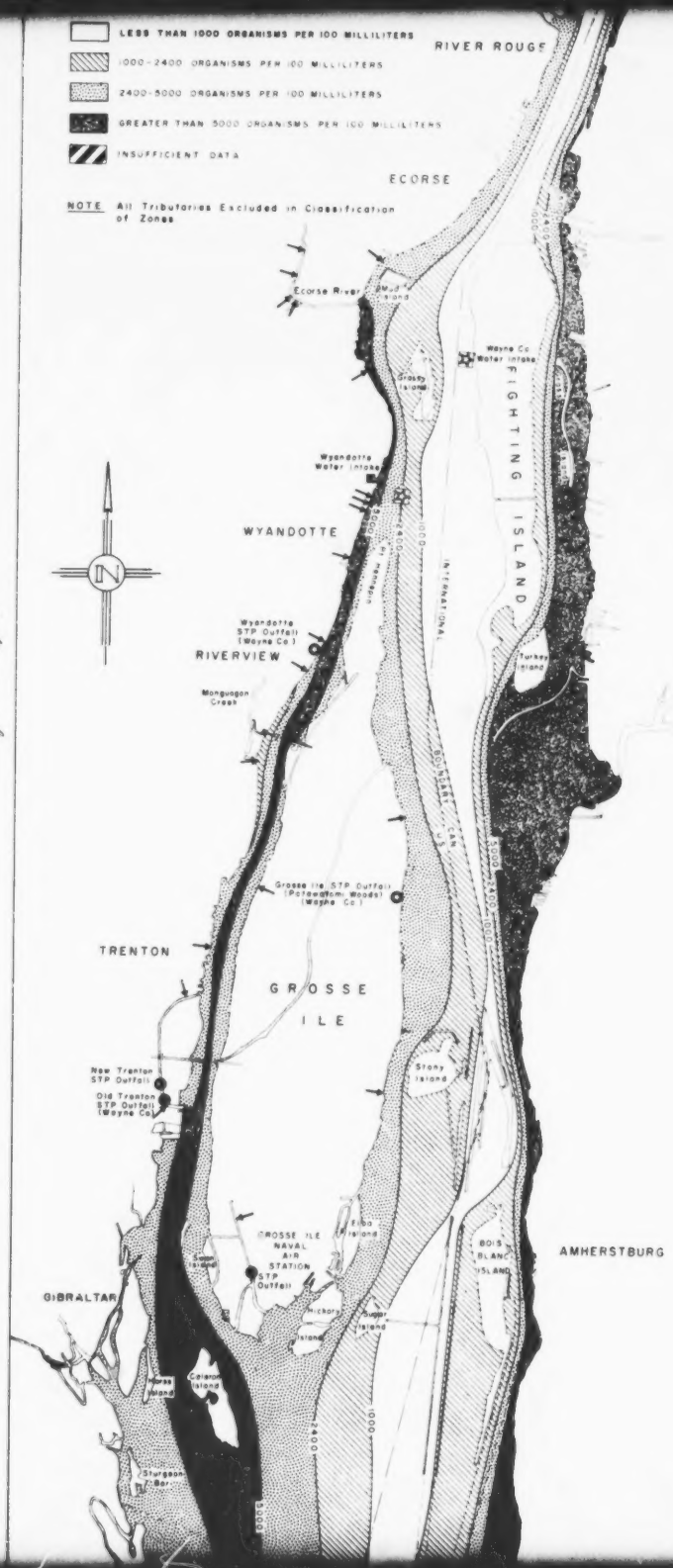
FEET

MILES




AREA LOCATION MAP
LAKE HURON
PORT HURON
MICHIGAN
LAKE ST CLAIR
DETROIT
Rouge River
WINDSOR
ONTARIO
Huron River
Raisin River
LAKE ERIE
TOLEDO
SCALE IN MILES
MICHIGAN
LAKE ST CLAIR
DETROIT
Detroit Water Intake
BELLE ISLE
Belle Isle STP Outfall
WINDSOR
ROUGE
Detroit STP Auxiliary Outfall
RIVER
ZUG ISLAND
Detroit STP Outfall
RIVER ROUGE
ONTARIO
ECORSE
Ecorse River
Mud Island
Wayne Co. Water Intake
Grosse Ile Island
FIGHT
LEGEND
DOMESTIC WATER INTAKE
SEWAGE TREATMENT PLANT OUTFALLS
COMBINED SEWER OVERFLOWS
LESS THAN 1000 ORGANISMS PER 100 MILLILITERS
1000-2400 ORGANISMS PER 100 MILLILITERS
2400-5000 ORGANISMS PER 100 MILLILITERS
GREATER THAN 5000 ORGANISMS PER 100 MILLILITERS
INSUFFICIENT DATA
NOTE All Tributaries Excluded in Classification of Zones.

139 g



ONTARIO

133 A

FIGURE 3-V

DETROIT RIVER-LAKE ERIE PROJECT

ZONES OF GEOMETRIC MEAN COLIFORM CONCENTRATIONS DRY CONDITIONS

DETROIT RIVER

U.S. DEPARTMENT OF HEALTH, EDUCATION, AND WELFARE
PUBLIC HEALTH SERVICE
REGION V GROSSE ILE, MICHIGAN

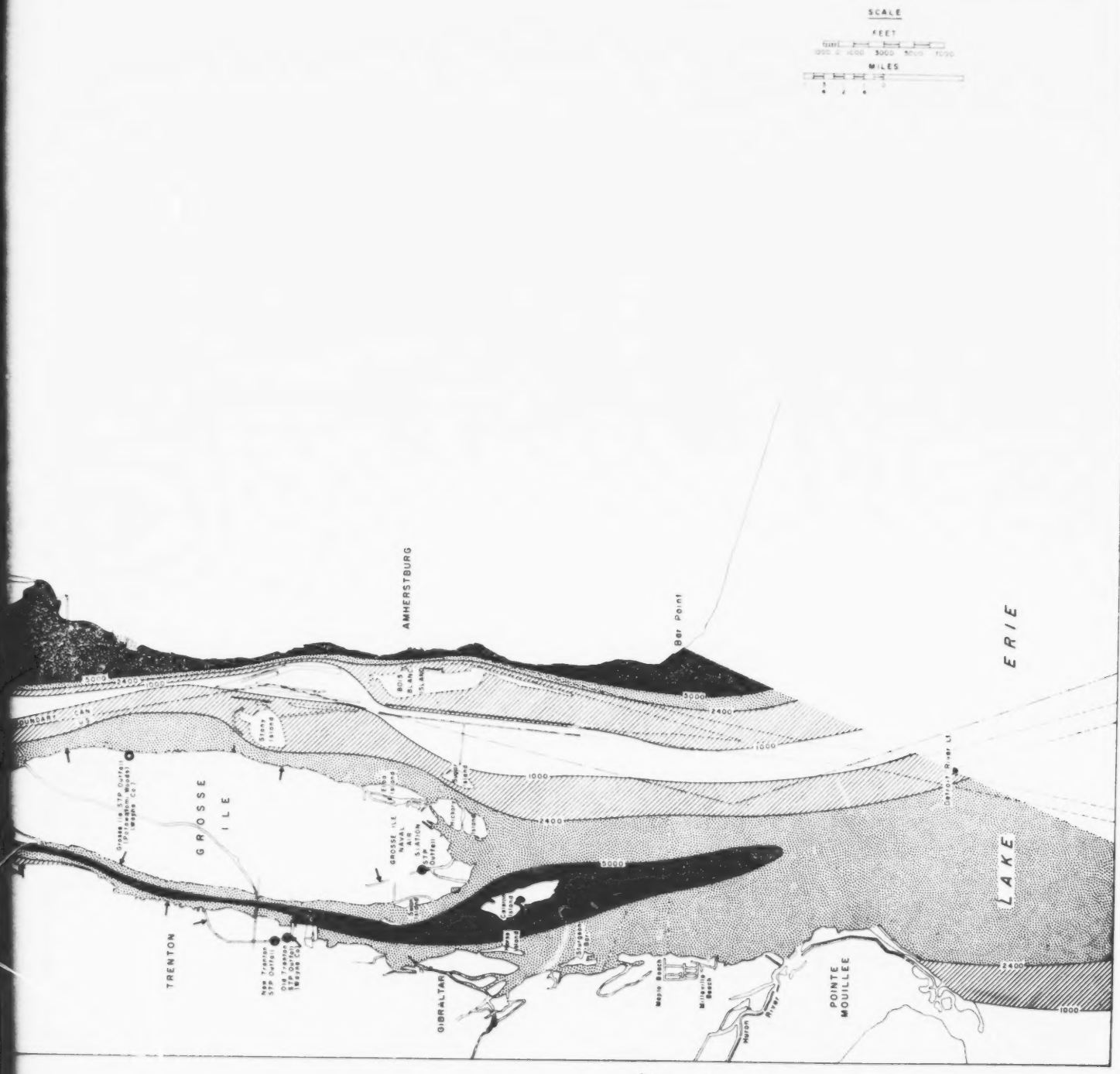
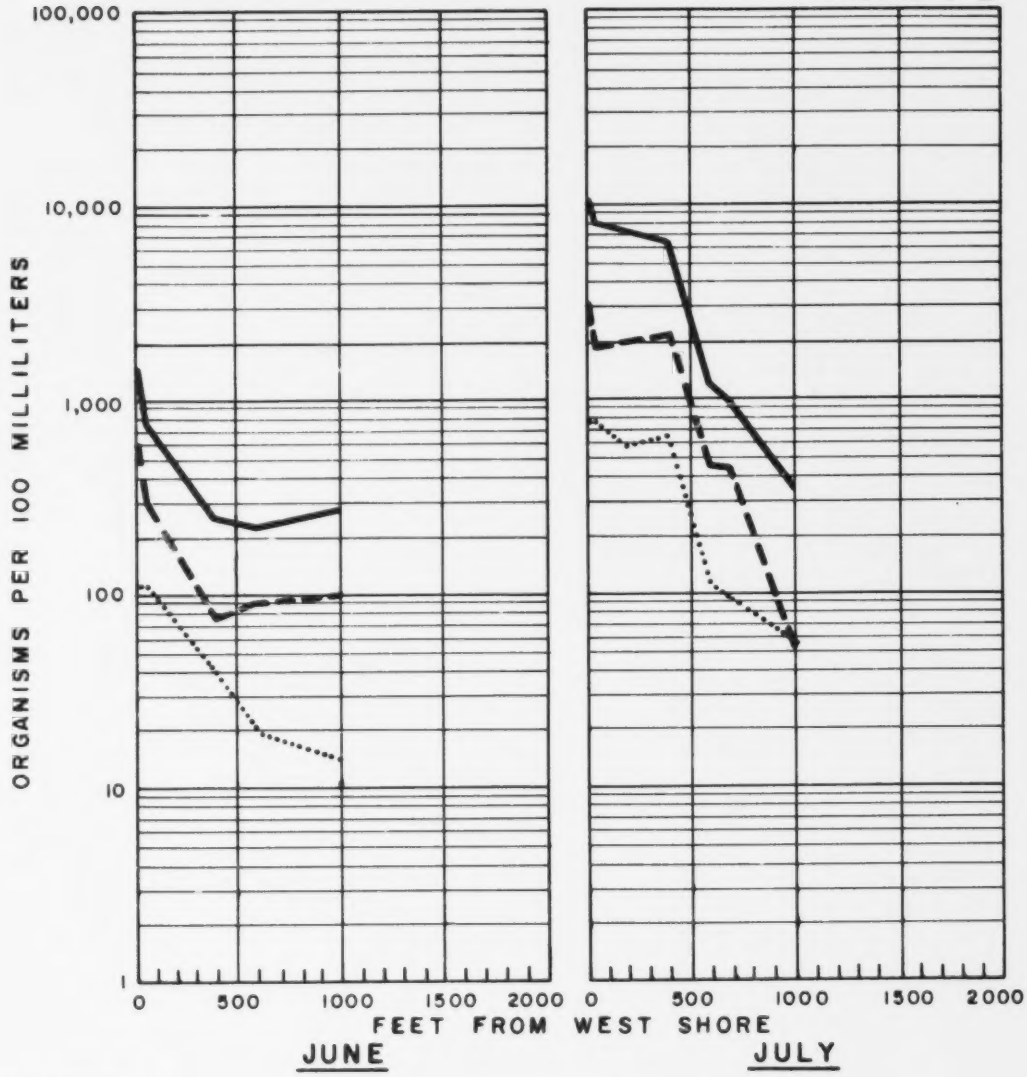


FIGURE 5-V



LEGEND

TOTAL COLIFORM

FECAL COLIFORM

FECAL STREPTOCOCCI

ALL VALUES GEOMETRIC MEANS

DETROIT RIVER–LAKE ERIE PROJECT

TOTAL COLIFORM, FECAL COLIFORM & FECAL STREPTOCOCCI
JUNE & JULY 1963 INTENSIVE SURVEYS
RANGE DT 20.6

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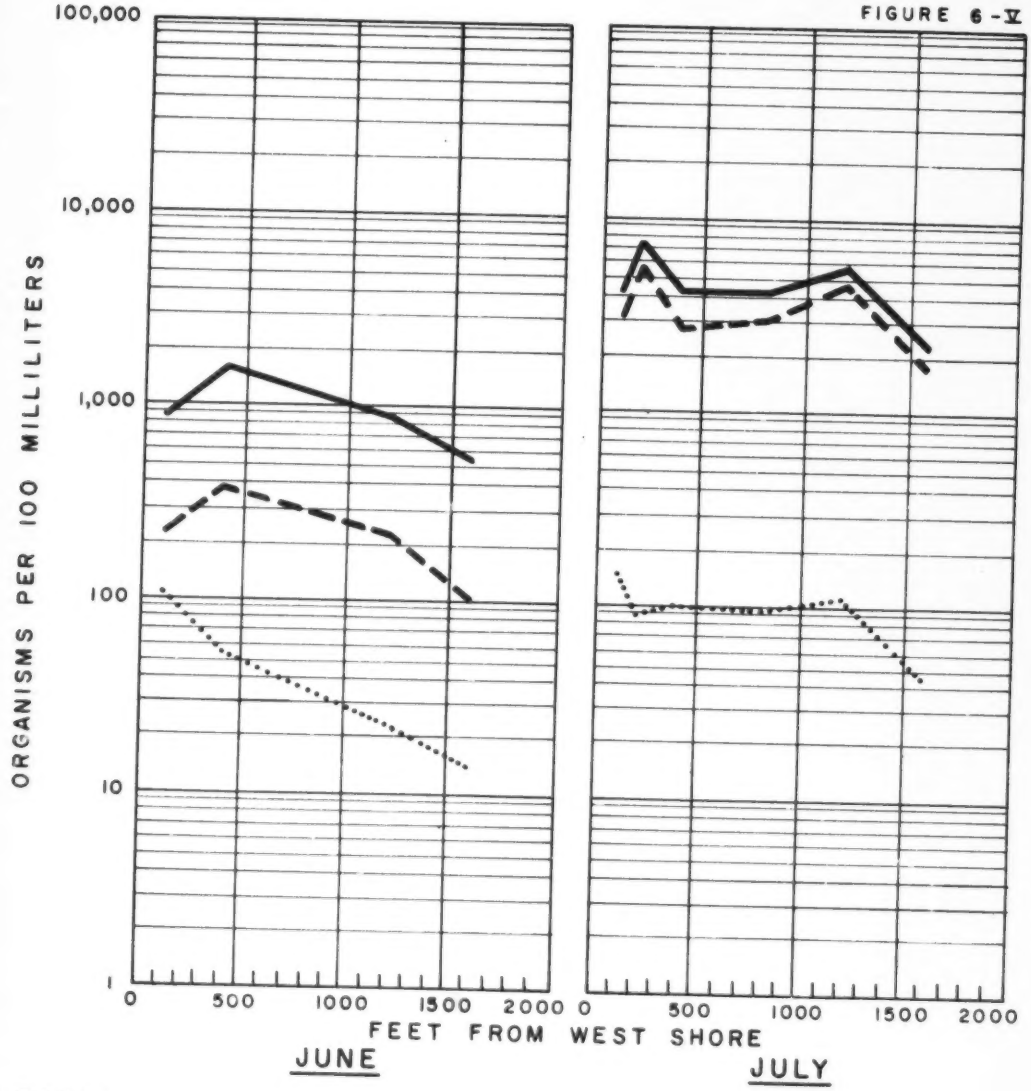
PUBLIC HEALTH SERVICE
REGION V GROSSE ILE, MICHIGAN



LEGEND

TOTAL COLIFORM

FECAL COLIFORM

FECAL STREPTOCOCCI

ALL VALUES GEOMETRIC MEANS

DETROIT RIVER–LAKE ERIE PROJECT

TOTAL COLIFORM, FECAL COLIFORM & FECAL STREPTOCOCCI

JUNE & JULY 1963 INTENSIVE SURVEYS

RANGE DT17.4W

U.S. DEPARTMENT OF HEALTH, EDUCATION, & WELFARE

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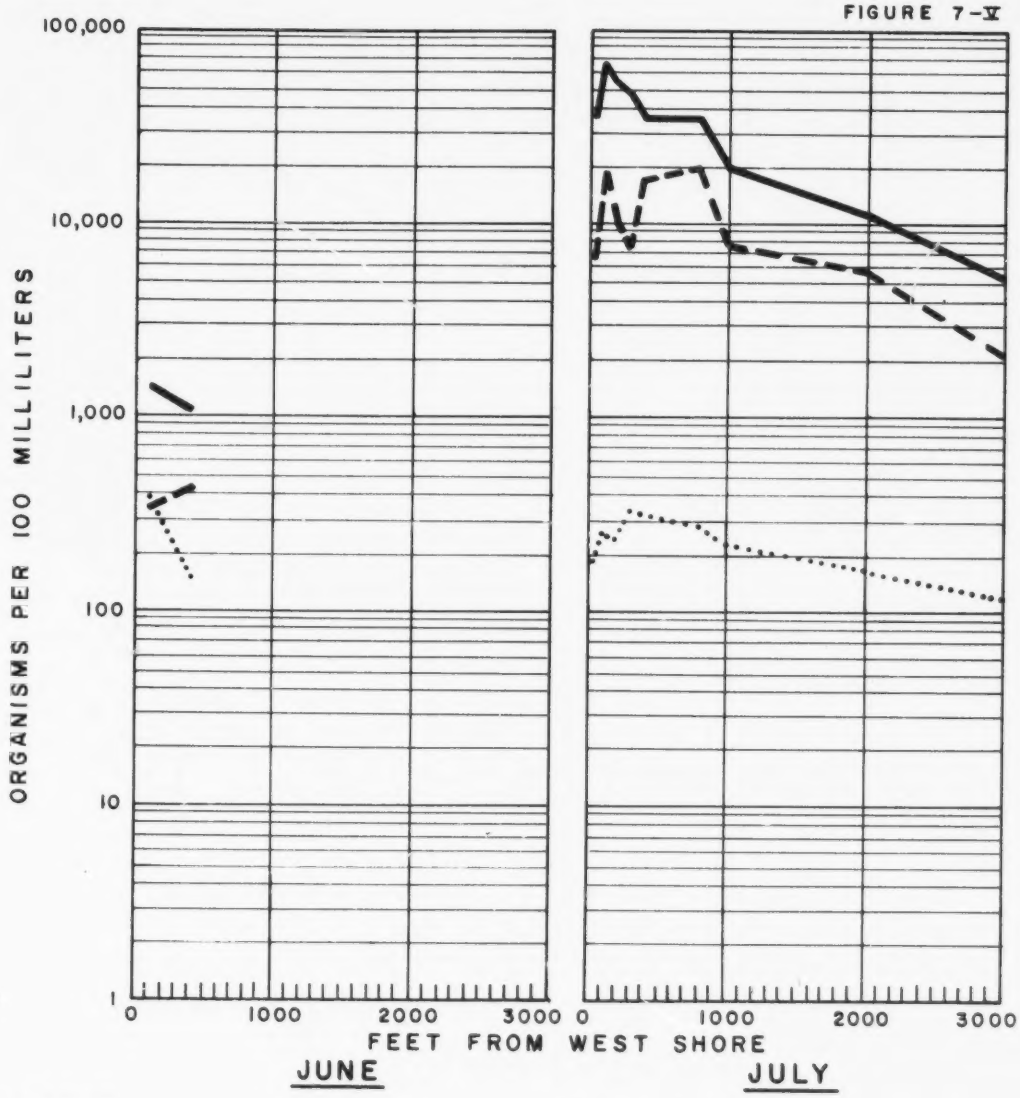
FIGURE 7-V



LEGEND

TOTAL COLIFORM

FECAL COLIFORM

FECAL STREPTOCOCCI

ALL VALUES GEOMETRIC MEANS

DETROIT RIVER–LAKE ERIE PROJECT

TOTAL COLIFORM, FECAL COLIFORM & FECAL STREPTOCOCCI
JUNE & JULY 1963 INTENSIVE SURVEYS
RANGE DT14.6W

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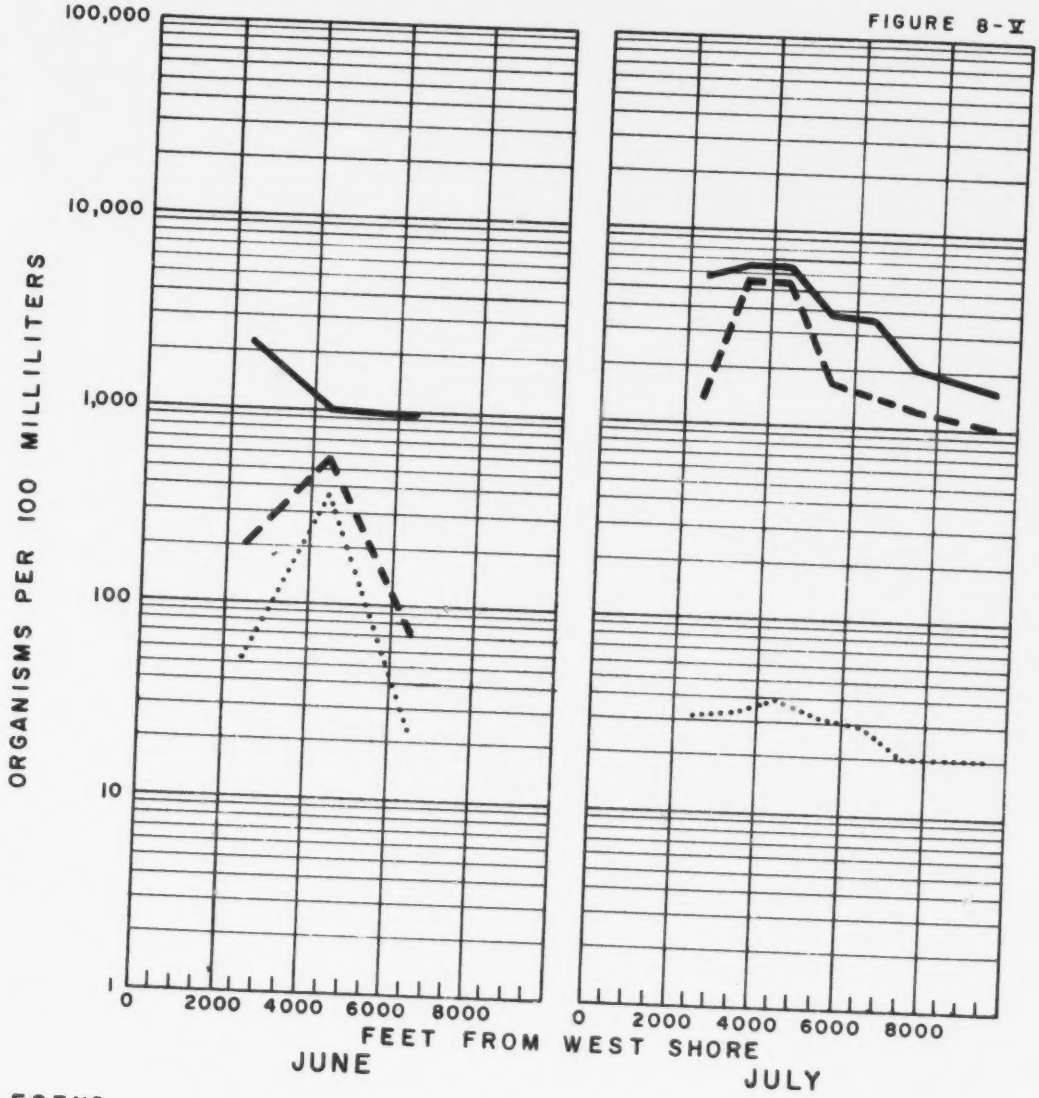
PUBLIC HEALTH SERVICE
REGION V GROSSE ILE, MICHIGAN



LEGEND

TOTAL COLIFORM

FECAL COLIFORM

FECAL STREPTOCOCCI

ALL VALUES GEOMETRIC MEANS

DETROIT RIVER-LAKE ERIE PROJECT

TOTAL COLIFORM, FECAL COLIFORM & FECAL STREPTOCOCCI
JUNE & JULY 1963 INTENSIVE SURVEYS
RANGE DT 3.9

U.S. DEPARTMENT OF HEALTH, EDUCATION, & WELFARE
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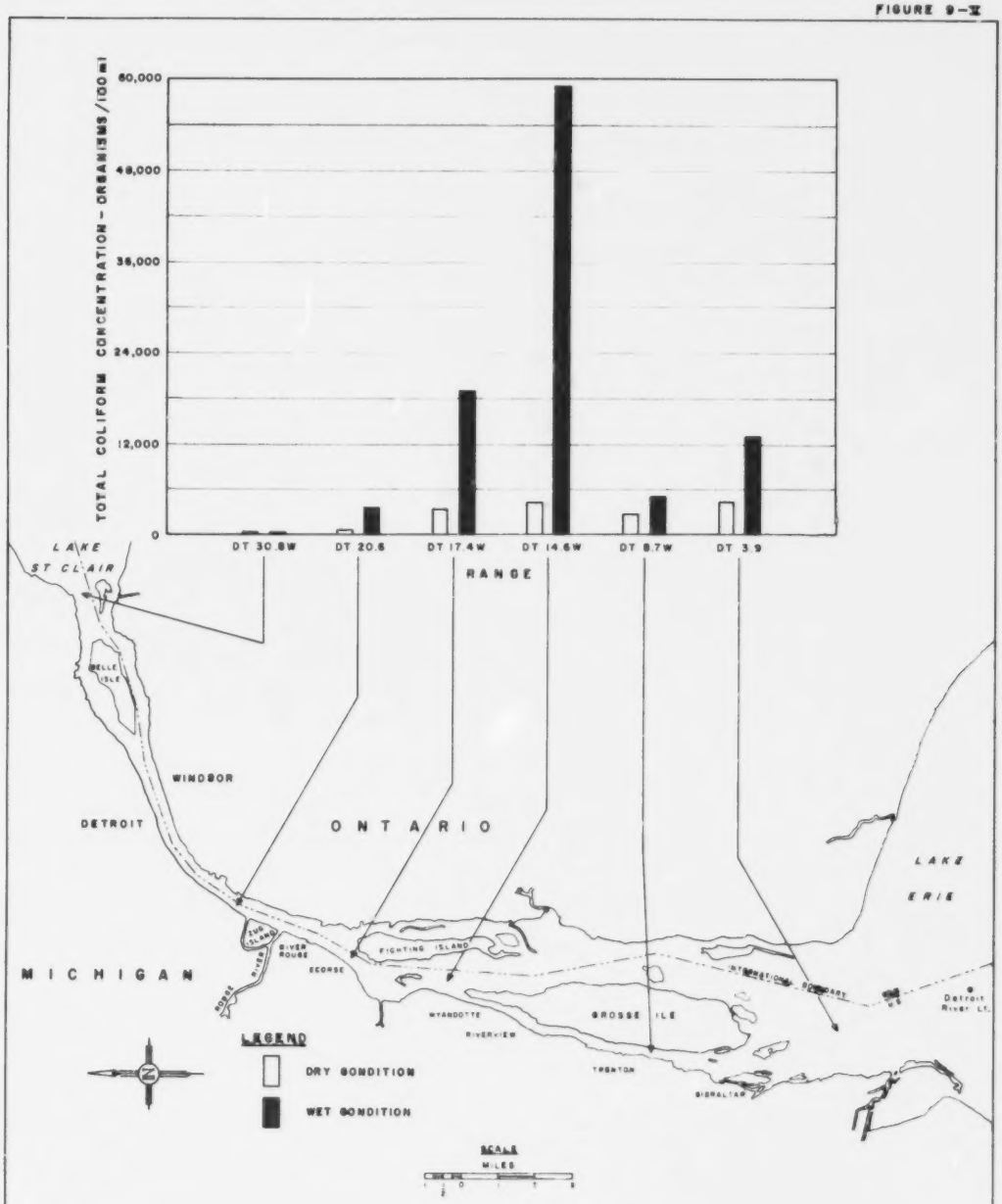
FIGURE 9-X



DETROIT RIVER-LAKE ERIE PROJECT

GEOMETRIC MEAN COLIFORM CONCENTRATIONS DURING WET & DRY CONDITIONS

STATION NEAREST U.S. SHORE

DETROIT RIVER

U.S. DEPARTMENT OF HEALTH, EDUCATION, & WELFARE
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coliform organisms per 100 ml during wet conditions. Fecal streptococcus results averaged 5,900 organisms per 100 ml, with fecal coliform 45 per cent of the total coliform densities.

Monguagon Creek, in the lower River, averaged 420 total coliform organisms per 100 ml during the survey, with correspondingly low fecal coliform results.

Table 1-V lists maximum observed bacteriological values and expected 95 per cent levels at key ranges in the Detroit River and its tributaries. (The 95 per cent values represent levels which can be expected to be exceeded 5 per cent of the time and not to be exceeded 95 per cent of the time.) The table shows a maximum value of 4,900 total coliform organisms per 100 ml at the head of the Detroit River, increasing to 770,000 organisms per 100 ml below the Rouge River and 430,000 organisms per 100 ml at the mouth of the River. The 95 per cent levels at these same locations during dry conditions are 3,900, 84,000, and 260,000 total coliform organisms per 100 ml respectively. During wet conditions the corresponding values are 15,000, 16,000,000, and 11,000,000 total coliform organisms per 100 ml. It is interesting to note that only one of 216 samples at the head of the Detroit River exceeded 1,000 total coliform organisms per 100 ml.

Table 1-V also shows the expected variation or standard error of the mean coliform densities computed for ranges in the Detroit River during dry and wet conditions. This table shows a wide spread in the 95 per cent values during wet conditions and a relatively small variation from the mean during dry weather. The table also shows a narrow range of expected variation in the mean value, indicating reliable estimates of this statistic. For example, the true mean coliform value at the head of the Detroit River during dry conditions can be estimated to lie within the limits of 74 and 170 organisms per 100 ml with 95 per cent confidence. The extreme variation in the 5 per cent and 95 per cent tolerance limits for coliform values at certain stations is attributable to a relatively small sample size encountered during wet conditions compared to the number of samples collected during dry conditions.

Figure 9-V shows the increase in geometric mean densities of total coliform organisms from the head of the Detroit River at the station nearest the United States shore. These values, under wet conditions, increased from 130 organisms per 100 ml at the headwaters, to 3,500 per 100 ml just above the Rouge River, to 59,000 in the lower River and, finally, a decrease to 15,000 per 100 ml at the mouth. Corresponding average densities during dry conditions were 110, 550, 4,300, and 4,000 per 100 ml respectively.

TABLE 1-V. TOTAL COLIFORM DENSITIES SUMMARY STATISTICS
WET AND DRY CONDITIONS

		DRY					WET				
					Tolerance Limit					Tolerance Limit	
Range	Maximum Value	Geo. Mean	Geo.Mean + 2 SE_A	Geo.Mean - 2 SE_A	Upper (95%)	Lower (5%)	Geo. Mean	Geo.Mean + 2 SE_A	Geo.Mean - 2 SE_A	Upper (95%)	Lower (5%)
DT 30.8W											
100'	710	110	170	74	3,900	3	130	230	70	6,600	2
300'	700	68	100	45	3,300	1	87	160	48	15,000	< 1
500'	300	42	64	28	870	2	37	73	19	5,200	< 1
1,000'	200	24	37	16	570	1	22	41	12	10,000	< 1
2,500'	130	15	23	10	500	< 1	19	34	10	5,100	< 1
DT 30.7E											
500'*	100	15	34	7	360	< 1	67	130	35	5,000	< 1
850'*	1,100	40	95	17	3,300	< 1	58	120	28	140,000	< 1
980'*	86,000	1,300	3,100	530	570,000	3	1,200	2,500	570	750,000	2
DT 28.4W											
100'	40,000	260	400	170	16,000	4	680	2,200	220	**	
300'	6,700	61	95	39	3,700	< 1	210	670	66		
700'	2,600	40	62	26	1,300	1	130	460	35		
1,300'	360	38	60	24	1,100	1	53	170	17		
DT 26.8W[a]											
52'	3,500	300	490	180	7,300	12					
169'	4,200	260	420	160	6,400	10					
292'	570	91	150	57	2,100	4					
421'	930	49	80	31	2,200	1		Insufficient wet data to compute results			
689'	140	24	38	15	490	1					
1,094'	270	11	17	7	190	< 1					
1,478'	140	10	17	6	340	< 1					
1,903'	420	11	18	7	250	< 1					

a - sampled 11-19-62 through 4-10-63 only.
* - Canadian stations
** - Insufficient data to determine tolerance limits

TABLE 1-V. TOTAL COLIFORM DENSITIES - SUMMARY STATISTICS
WET AND DRY CONDITIONS – Continued

Range	Maximum Value	DRY Geo. Mean	DRY Geo.Mean + 2 SE_A	DRY Geo.Mean - 2 SE_A	DRY Tolerance Limit Upper (95%)	DRY Tolerance Limit Lower (5%)	WET Geo. Mean	WET Geo.Mean + 2 SE_A	WET Geo.Mean - 2 SE_A	WET Tolerance Limit Upper (95%)	WET Tolerance Limit Lower (5%)
DT 25.7											
50'	390,000	1,200	2,100	630	43,000	31	7,100	17,000	3,000	**	
100'	540,000	530	980	290	9,800	29	2,300	5,000	1,100		
300'	780,000	240	460	150	4,900	12	680	1,600	290		
600'	20,000	72	130	39	2,900	2	150	330	70		
2,000'	310	26	48	14	490	1	54	130	23		
3,400'	120,000	1,300	2,500	720	270,000	7	7,900	21,000	3,000		
DT 20.6											
5'	32,000	530	810	340	5,200	54	3,600	29,000	580	**	
50'	310,000	580	890	380	5,600	61	4,800	30,000	770		
200'	270,000	560	860	360	4,600	69	6,600	42,000	1,100		
400'	220,000	250	380	170	2,700	24	6,700	42,000	1,100		
600'	12,000	130	200	87	2,300	8	1,100	6,700	170		
700'	120,000	130	200	81	1,600	10	1,800	8,600	360		
1,000'	100,000	120	180	76	2,700	5	510	2,800	94		
1,500'	70,000	270	420	170	11,000	6	810	4,000	170		
1,800'	51,000	1,000	1,700	660	31,000	35	1,500	9,600	240		
2,000'	44,000	4,300	6,900	2,700	60,000	310	7,300	36,000	1,500		
2,300'	85,000	14,000	22,000	8,700	470,000	420	26,000	140,000	4,700		
DT 19.0											
100'	440,000	3,800	8,200	1,700			54,000	540,000	5,300		
200'	750,000	4,300	9,400	2,000			80,000	820,000	7,900		
300'	860,000	3,600	7,800	1,600			82,000	830,000	8,100	**	
400'	750,000	3,300	7,200	1,500	**		75,000	760,000	7,400		
800'	890,000	240	510	110			9,500	96,000	930		
1,000'	700,000	160	350	74			8,400	85,000	830		
1,500'	100	67	220	21							
2,000'	400	140	440	43							
2,200'	300	130	490	36							

TABLE 1-V. TOTAL COLIFORM DENSITIES SUMMARY STATISTICS
WET AND DRY CONDITIONS — Continued

Range	Maximum Value	DRY Geo. Mean	DRY Geo.Mean + 2 SE_A	DRY Geo.Mean - 2 SE_A	DRY Tolerance Limit Upper (95%)	DRY Tolerance Limit Lower (5%)	WET Geo. Mean	WET Geo.Mean + 2 SE_A	WET Geo.Mean - 2 SE_A	WET Tolerance Limit Upper (95%)	WET Tolerance Limit Lower (5%)
DT 19.0 cont.											
2,300'	1,800	560	1,800	180							
2,400'	10,000	2,300	7,400	720							
2,500'	18,000	4,900	16,000	1,500							
DT 17.4W											
100'	250,000	3,300	4,900	2,200	51,000	210	19,000	38,000	9,600	2,100,000	170
200'	450,000	4,400	6,700	3,000	56,000	350	18,000	37,000	8,400	13,000,000	23
400'	140,000	3,500	5,200	2,300	36,000	340	15,000	30,000	7,500	2,000,000	110
800'	310,000	2,700	4,100	1,800	33,000	230	13,000	27,000	6,100	4,000,000	41
1,200'	300,000	1,000	1,600	700	54,000	20	5,000	10,000	2,500	4,900,000	6
1,600'	19,000	590	880	390	14,000	24	2,500	5,100	1,300	2,000,000	3
2,200'*	17,000	390	600	260	9,600	16	650	1,400	310	390,000	1
DT 17.0E											
400'*	28,000	3,200	4,700	2,100	73,000	140	8,200	14,000	4,800	340,000	190
700'*	41,000	9,500	14,000	6,400	100,000	870	13,000	30,000	7,400	130,000	1,300
900'*	110,000	21,000	32,000	14,000	170,000	2,600	23,000	40,000	14,000	500,000	1,100
DT 14.6W											
20'	630,000	4,200	5,900	3,000	84,000	210	59,000	94,000	37,000	16,000,000	220
100'	770,000	4,900	6,800	3,500	42,000	560	47,000	75,000	30,000	13,000,000	170
200'	620,000	3,800	5,400	2,700	60,000	250	50,000	80,000	32,000	6,300,000	400
300'	480,000	3,800	5,600	2,700	46,000	330	31,000	49,000	20,000	6,000,000	160
400'	520,000	3,700	5,200	2,700	38,000	360	41,000	67,000	25,000	6,300,000	270
800'	440,000	2,800	3,100	1,600	33,000	140	36,000	57,000	22,000	12,000,000	110
1,000'	380,000	2,100	3,000	1,500	30,000	140	26,000	42,000	17,000	3,700,000	190
2,000'	200,000	1,500	2,200	1,100	49,000	48	16,000	25,000	10,000	3,300,000	77
3,000'	55,000	650	940	460	37,000	12	7,200	11,000	4,500	790,000	65

TABLE 1-V. TOTAL COLIFORM DENSITIES - SUMMARY STATISTICS
WET AND DRY CONDITIONS – Continued

Range	Maximum Value	DRY Geo. Mean	DRY Geo.Mean + 2 SE_A	DRY Geo.Mean - 2 SE_A	DRY Tolerance Limit Upper (95%)	DRY Tolerance Limit Lower (5%)	WET Geo. Mean	WET Geo.Mean + 2 SE_A	WET Geo.Mean - 2 SE_A	WET Tolerance Limit Upper (95%)	WET Tolerance Limit Lower (5%)
DT 12.0W											
122'	14,000	2,100	3,400	1,300	170,000	27	2,100	4,900	890	350,000	10
322'	110,000	4,000	6,400	2,400	93,000	170	10,000	29,000	3,600	1,300,000	83
670'	340,000	6,100	9,800	3,800	190,000	200	11,000	25,000	4,600	730,000	160
DT 9.6W											
100'	50,000	2,900	4,500	1,900			23,000	39,000	10,000		
300'	60,000	5,600	8,600	3,600			16,000	27,000	9,800	**	**
500'	60,000	5,900	9,200	3,800			13,000	22,000	7,800		
900'	33,000	4,800	7,500	3,100			6,600	11,000	3,900		
DT 9.3E											
500'	67,000	3,000	3,900	2,300	43,000	210	10,000	15,000	7,000	1,300,000	80
1,200'	66,000	2,200	2,900	1,700	180,000	27	10,000	15,000	6,700	990,000	100
2,000'	63,000	2,800	3,700	2,200	110,000	75	7,100	10,000	4,800	320,000	160
3,000'	53,000	1,900	2,500	1,500	67,000	57	6,100	9,000	4,200	190,000	190
4,000'*	40,000	1,300	2,100	810	97,000	17	2,500			49,000,000	< 1
4,500'*	23,000	670	1,200	460	19,000	30	2,800	**	**	440,000	18
5,000'*	37,000	3,200	5,100	2,000	100,000	100	6,400			610,000	66
5,600'*	80,000	12,000	19,000	7,500	370,000	390	16,000			500,000	540
DT 8.7W											
80'	61,000	2,700	3,700	2,000	54,000	140	5,900	9,000	3,800	420,000	82
280'	100,000	3,500	4,500	2,500	76,000	150	16,000	**	**	170,000	1,600
480'	550,000	4,900	6,600	3,700	110,000	230	33,000			880,000	1,300
680'	380,000	5,400	7,200	4,000	89,000	320	17,000	27,000	11,000	2,800,000	110
980'	450,000	5,500	7,400	4,100	85,000	360	15,000	22,000	9,400	1,000,000	210
1,240'	230,000	4,300	5,800	3,200	110,000	170	19,000	**	**	910,000	410

TABLE 1-V. TOTAL COLIFORM DENSITIES - SUMMARY STATISTICS
WET AND DRY CONDITIONS – Continued

		DRY					WET				
Range	Maximum Value	Geo. Mean	Geo.Mean + 2 SE_A	Geo.Mean - 2 SE_A	Tolerance Limit Upper (95%)	Tolerance Limit Lower (5%)	Geo. Mean	Geo.Mean + 2 SE_A	Geo.Mean - 2 SE_A	Tolerance Limit Upper (95%)	Tolerance Limit Lower (5%)
DT 3.9											
2,500'	94,000	4,100	6,600	2,500	250,000	68	13,000	26,000	7,000	270,000	670
3,500'	410,000	3,600	6,000	2,200	170,000	77	16,000	33,000	9,400	2,300,000	130
4,500'	330,000	5,900	9,500	3,600	180,000	200	20,000	38,000	11,000	2,700,000	160
5,500'	200,000	5,900	9,600	3,600	180,000	190	16,000	32,000	8,500	2,000,000	140
6,500'	320,000	3,800	6,200	2,400	210,000	70	8,900	27,000	4,600	11,000,000	7
7,500'	300,000	3,000	5,000	1,800	260,000	34	9,500	18,000	5,100	8,400,000	11
9,500'	110,000	2,000	3,300	1,200	120,000	33	2,700	5,000	1,400	1,200,000	6
11,500'*	80,000	1,200	2,000	690	31,000	45	3,300	6,200	1,700	1,900,000	6
13,500'*	47,000	920	1,600	530	38,000	22	3,600	6,800	1,900	760,000	17
15,000'*	73,000	1,100	1,900	630	38,000	31	2,300	4,500	1,200	810,000	6
16,500'*	58,000	2,800	4,800	1,600	130,000	61	3,700	6,900	2,000	1,800,000	8
17,500'*	54,000	6,500	11,000	3,800	90,000	470	7,500	14,000	4,000	290,000	190
18,500'*	42,000	11,000	19,000	6,200	97,000	1,200	12,000	23,000	6,400	180,000	830
19,000'*	51,000	11,000	19,000	6,100	95,000	1,200	15,000	27,000	7,700	290,000	730
19,300'*	39,000	11,000	19,000	6,000	100,000	1,100	12,000	24,000	6,100	260,000	555

Chemical and Physical

Phenols

High levels of phenols in waters cause disagreeable tastes and odors in drinking water, taint the flesh of game fish, and will kill fish when concentrations are excessive. If phenols are present in raw water supplies in sufficient concentration to cause tastes and odors, expensive water treatment procedures may be required to eliminate the problem. IJC objectives call for average phenol concentrations not to exceed 2 μg/l (ppb) and maximum values not to exceed 5 μg/l (ppb) to prevent taste and odors in water supplies.

Phenol concentrations at all ranges in the Detroit River exceeded these criteria during the study period. Water quality at the head of the Detroit River met these criteria in 1962 but not 1963.

Records of the International Joint Commission reveal phenol concentrations frequently in excess of 10 μg/l in the St. Clair River below known sources of phenolic wastes. The flow in the St. Clair River accounts for 95 per cent of the flow of the Detroit River. The weighted average phenol concentration near the mouth of the St. Clair River during the period of the survey was 9 μg/l, representing a loading of 8,700 pounds of phenolic substances per day. Phenol concentrations in the lower Detroit River near the United States shore exceed IJC objectives over 80 per cent of the time. The maximum values of phenol concentrations during the survey approached levels toxic to fish.

Major sources of phenol concentrations in the Detroit River are the Detroit Sewage Treatment Plant, Ford Motor Company, Great Lakes Steel Blast Furnace, Mobil Oil Company, Pennsalt Chemical Corporation West Plant, and Wyandotte Chemical Corporation North Works.

Phenolic pollution in the lower Detroit River could cause objectionable tastes and odors in both drinking water and fish flesh. While average concentrations in the upper river are above IJC objectives of 2 μg/l (ppb), they are usually not above the 5μ g/l (ppb) level at which most observers detect objectionable tastes and odors in water supplies.

Average phenol concentrations in the upper Detroit River ranged from 3 to 5 μg/l. Just below the Rouge River at a station near the United States shore the average value increased to 28 μg/l with lower values observed in mid-river. Further downstream but above the Trenton channel these average values decreased to 10 μg/l near the western shore. In the Trenton channel the average values rose to 30 μg/l near the shore and then decreased to 6 - 9 μg/l at the mouth. Figure 10-V shows average phenol concentrations in the Detroit River.

Phenols did not exhibit any type of normal statistical distribution; thus extreme values are shown in Figure 10-V and Table 2-V as the maximum observed value at several key locations and the per cent of samples exceeding 2 μg/l and 5 μg/l. At the head of the river 40 - 55 per cent of the samples exceeded 2 μg/l while 17 - 35 per cent exceeded 5 μg/l. Just above the Rouge River 38 - 59 per cent exceeded 2 μg/l while 23 - 54 per cent exceeded 5 μg/l. Below the Rouge River 27 - 88 per cent exceeded 2 μg/l and 6 - 69 per cent exceeded 5 μg/l. At the mouth of the river 40 - 84 per cent of the samples exceeded 2 μg/l and 19 - 68 per cent of the samples exceeded 5 μg/l. The maximum value observed in the Detroit River during the survey was 650 μg/l and the next highest value was 180 μg/l, observed in the Trenton channel.

Table 3-V shows average and extreme phenol concentrations in the tributaries of the Detroit River. A maximum value of 10,980 μg/l was observed in Monguagon Creek and 290 μg/l in the Rouge River. Average phenol concentrations in the Rouge River, Conners Creek, and Monguagon Creek were 12, 6, and 1,500 μg/l respectively.

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TABLE 2-V. AVERAGE AND EXTREME PHENOL CONCENTRATIONS - DETROIT RIVER

Range	Feet	Maximum Concentration Observed µg/l	Average µg/l	Percent >2 µg/l	Percent >5 µg/l
DT 30.8W	100	12	3	58	13
	300	27	4	48	16
	500	18	4	56	24
	1,000	9	3	56	24
	2,500	21	4	50	16
DT 30.7E	500*	10	3	50	25
	850*	11	4	53	35
	980*	28	5	56	33
DT 28.4W	100	10	2	27	14
	300	13	2	36	9
	700	17	3	29	19
	1,300	11	2	33	19
DT 26.8W	52	32	6	61	33
	169	28	7	61	39
	292	70	8	61	39
	421	31	5	47	35
	689	19	5	39	33
	1,094	14	3	47	24
	1,478	13	4	53	27
	1,903	16	4	47	29
DT 25.7	50	14	3	33	22
	100	28	5	47	21
	300	11	3	42	21
	600	48	5	25	20
	2,000	49	5	32	21
	3,400*	49	6	42	21
DT 20.6	5	24	4	36	20
	50	650	5	50	31
	200	26	5	38	23
	400	50	6	44	28
	600	34	7	46	38
	700	24	4	42	23
	1,000	37	5	38	35
	1,500*	35	4	35	19
	1,800*	40	4	30	9
	2,000*	20	2	25	17
	2,300*	25	3	42	21

* = Canadian Stations.

TABLE 2-V. AVERAGE AND EXTREME PHENOL CONCENTRATIONS - DETROIT RIVER – Continued

Range	Feet	Maximum Concentration Observed µg/l	Average µg/l	Percent >2 µg/l	Percent >5 µg/l
DT 19.0	100	79	28	100	100
	200	49	20	80	80
	300	36	16	100	80
	400	28	18	80	80
	800	9	2	40	20
	1,000	27	8	50	25
DT 17.4W	100	47	10	89	63
	200	43	9	84	56
	400	23	8	77	50
	800	50	8	73	42
	1,200	8	3	56	16
	1,600	7	3	42	19
	2,200*	9	2	28	8
DT 17.0E	400*	24	3	24	19
	700*	15	3	35	15
	900*	28	3	33	10
DT 14.6W	20	29	7	75	46
	100	24	7	68	48
	200	16	6	75	46
	300	158	5	67	46
	400	16	5	83	46
	800	16	4	63	29
	1,000	11	3	65	17
	2,000	4	2	35	0
	3,000	6	2	21	8
DT 12.0W	122	35	10	89	66
	322	124	8	81	52
	670	26	7	85	48
DT 9.6W	100	11	5	67	33
	300	11	5	67	33
	500	5	3	67	0
	900	20	8	67	33
DT 9.3E	500	11	2	39	13
	1,200	8	2	29	13
	2,000	84	6	39	9
	3,000	6	1	21	4
	4,000*	4	1	30	0
	4,500*	10	2	26	9
	5,000*	4	1	9	0
	5,600*	31	2	27	5

TABLE 2-V. AVERAGE AND EXTREME PHENOL CONCENTRATIONS - DETROIT RIVER – Continued

Range	Feet	Maximum Concentration Observed µg/l	Average µg/l	Percent >2 µg/l	Percent >5 µg/l
DT 8.7W	80	180	30	95	95
	280	50	12	92	78
	480	140	13	88	69
	680	23	8	83	62
	980	31	8	80	66
	1,240	19	6	74	49
DT 3.9	2,500	36	9	81	70
	3,500	42	7	70	48
	4,500	42	6	63	33
	5,500	19	4	63	33
	6,500	19	5	61	25
	7,500	12	4	56	30
	9,500	32	4	41	19
	11,500*	10	4	48	20
	13,500*	29	3	33	17
	15,000*	20	4	42	13
	16,500*	24	3	35	9
	17,500*	17	3	32	8
	18,500*	6	2	25	4
	19,000*	8	2	23	5
	19,300*	39	3	24	5

TABLE 3-V
AVERAGE AND EXTREME PHENOL CONCENTRATION TRIBUTARIES TO DETROIT RIVER

Range	Maximum Concentration Observed μg/l	Average μg/l	Percent >2μg/l	Percent >5 μg/l
Conners Creek	22	6	69	42
Rouge River	167	19	79	66
Monguagon Creek	10,980	1,490	98	98
Ecorse Creek	23	5	59	41

Suspended and Settleable Solids

Excessive amounts of suspended solids in water can interfere with domestic and industrial water treatment processes, cause harmful effects to fish and other aquatic life by clogging their gills and respiratory passages, cause turbidity which interferes with light transmission, and interfere with boating and aesthetic enjoyment of water. When a part of the suspended solids settles out on stream and lake bottoms as sludge or bottom deposits, damage to aquatic life can occur from the blanketing of the bottom, killing eggs and essential fish-food organisms, and destroying spawning beds. In addition, toxic materials, sometimes carried with suspended solids, can leech out and destroy aquatic life. Suspended solids cause especially serious problems in shallow, slow-moving waters, where they settle easily.

Suspended solids in the upper River were uniform with values of 5 - 10 mg/l in mid-river and values of 15 - 20 mg/l near the United States shore. In the lower River and at the mouth, these values increased to a range of 14 - 65 mg/l with the higher values near the United States shore. In the upper Detroit River the range of settleable solids was 5 - 10 mg/l while values in the lower River and the mouth were in the range 10 - 24 mg/l. In both cases the higher values were near the United States shore.

Average suspended solids in the tributaries of the Detroit River ranged from 22 mg/l in the Rouge River to 76 mg/l in Conners Creek and 162 mg/l in the Ecorse River.

Chlorides

Chloride concentrations above certain levels can interfere with domestic and industrial water supplies by causing objectionable tastes in drinking water, and corrosion in industrial processes.

Figure 11-V shows average chloride concentrations in the Detroit River. In the upper Detroit River the chloride concentration was uniform at 7 - 10 mg/l. Just below the Rouge River the mean chloride concentration increased to 9 - 35 mg/l with the higher values observed near the United States shore. In the lower river the mean values increased to 26 - 69 mg/l in the Trenton Channel and 28 - 58 mg/l at the mouth. Once again, the higher values were observed near the United States shore. Maximum values as high as 180 mg/l have occurred in the Detroit River.

Figure 4-V shows average chloride concentrations in five zones representing less than 10, 10-20, 20-35, 35-50, and greater than 50 mg/l. The upper Detroit River is in the first zone representing less than 10 mg/l. Below the Rouge River to Wyandotte, United States waters are predominantly in the second and third zones representing average values up to 35 mg/l. Below Wyandotte to the mouth, especially along the United States shore, the two zones representing average chloride concentration in excess of 35 mg/l predominate.

In the tributaries of the Detroit River high chloride values are most noticeable in the Rouge River with a mean value of 66 mg/l, Ecorse River with a mean value of 91 mg/l, and Monguagon Creek with a mean value of 360 mg/l.

Chlorides do not pollute the upper Detroit River. Below the Rouge River adjacent to the United States shore there is significant deterioration due to pollution from chloride sources. Mean values in excess of 50 mg/l could interfere with industrial water supply intakes located near the United States shore in the lower river.

Iron

Excessive concentrations of iron in water can cause interference with domestic and industrial water supplies by causing tastes and stains. Iron, in relatively low concentrations, is toxic to certain species of fish and other aquatic life. IJC objectives state that iron concentrations should not exceed 0.3 mg/l (ppm). Average iron concentrations in the upper Detroit River generally meet this objective. The Rouge River and the lower Detroit River, however, had concentrations in excess of this objective; concentrations below the Rouge River average over two times this value. The lower Detroit River, especially near the United States shore, is degraded and polluted by iron concentrations.

At the head of the Detroit River in United States water, average iron concentrations were 0.10 to 0.13 mg/l. Downstream just above the Rouge River, these values increased to 0.18 to 0.34 mg/l. Below the Rouge River, the average values near the United States shore increased to 0.39 to 0.52 mg/l. Downstream near Fighting Island, these values increased to 0.4 to 4.42 mg/l, with the higher values along the United States shore. Further downstream and in the Trenton Channel, the range was 0.47 - 0.63 mg/l. The maximum value observed during the survey of the Detroit River was 15.2 mg/l, approximately 5 miles downstream from the Rouge River.

Maximum iron concentrations between 1.5 and 2.6 mg/l were observed in the major tributaries of the Detroit River. Mean values at these tributaries ranged from 0.39 to 0.91 mg/l.

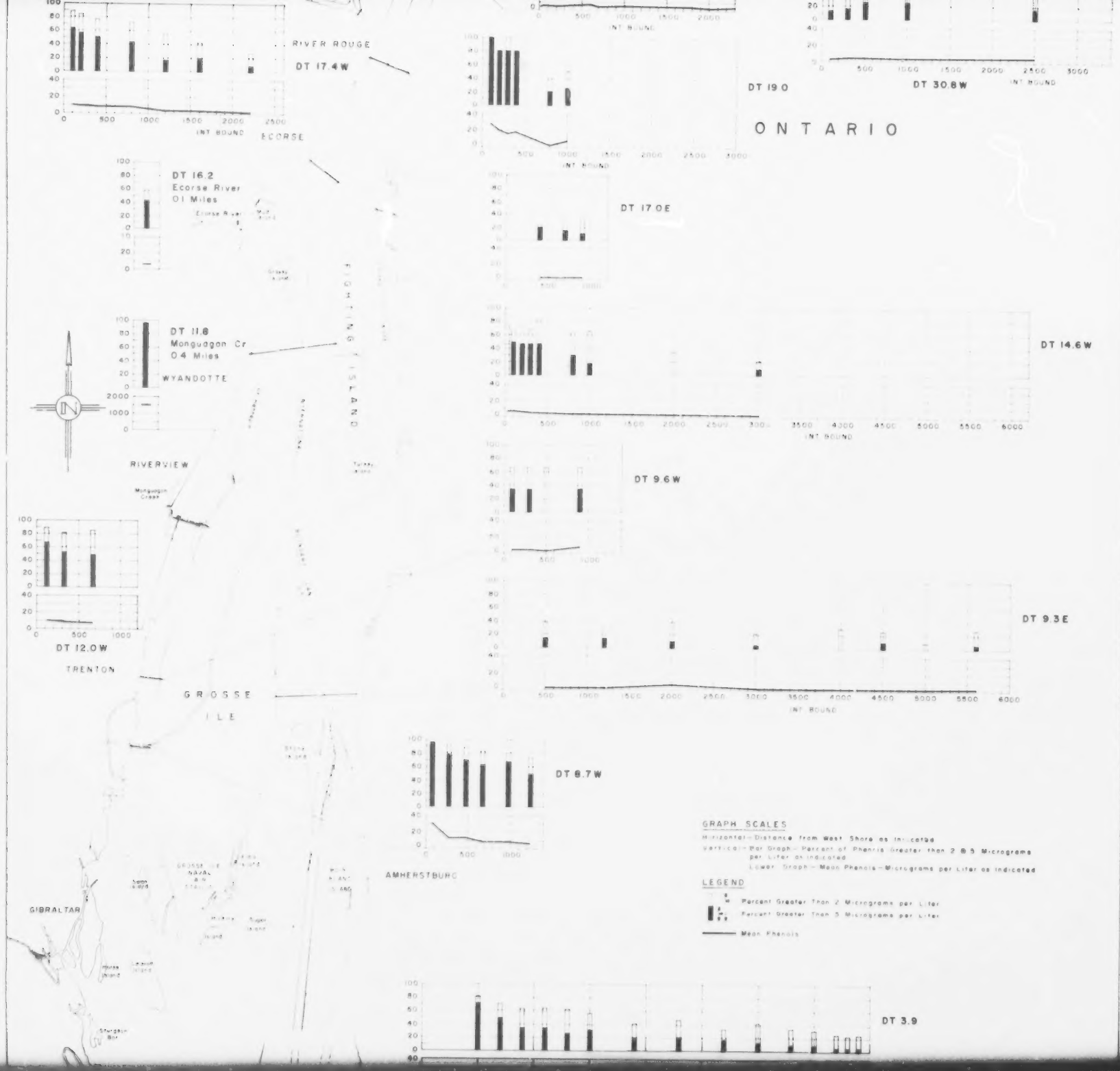
BOD and Dissolved Oxygen

Biochemical Oxygen Demand (BOD) is a measure of the amount of organic matter oxidized through biochemical processes. In general, a high BOD indicates the presence of a large amount of organic material. It is normal to find a BOD of 2 to 3 parts per million (or 2 or 3 mg/l) in river waters receiving natural drainage; a higher BOD may represent a drain on the dissolved oxygen present in the water.

The lack of dissolved oxygen (DO) in water creates an unfavorable environment for fish and other aquatic life. DO deficiencies can prevent propagation and, if great enough, kill fish. Low levels of DO can cause objectionable odors, thus interfering with recreational enjoyment of the water, and increase the corrosive properties of the water, thus interfering with domestic and industrial water supply.

In no reaches of the Detroit River do levels of dissolved oxygen cause interferences with water uses. However, a decrease in DO saturation, from 93 to 106% in the upper River to 67-82% at the mouth, due to the discharge of oxygen-consuming wastes in the vicinity of the Rouge River, is significant. Future problems may result if oxygen-consuming waste loads increase.

In the upper Detroit River, the BOD ranged from 2 to 4 mg/l. Below the Rouge River, the average value increased to 8 mg/l, but returned to the 2-4 mg/l range at the mouth. BOD in the Rouge River was less than 6 mg/l during the period sampled.


RIVER ROUGE
DT 17.4W
INT BOUND
ECORSE
DT 19.0
DT 30.8W
ONTARIO
DT 16.2
Ecorse River
01 Miles
DT 17.0E
DT 11.8
Monguagon Cr
0.4 Miles
WYANDOTTE
FIGHTING ISLAND
DT 14.6W
RIVERVIEW
DT 9.6W
DT 12.0W
TRENTON
DT 9.3E
GROSSE ILE
DT 8.7W
AMHERSTBURG
GIBRALTAR
DT 3.9
GRAPH SCALES
Horizontal - Distance from West Shore as indicated
Vertical - Bar Graph - Percent of Phenols Greater than 2 & 5 Micrograms per Liter as indicated
Lower Graph - Mean Phenols - Micrograms per Liter as indicated
LEGEND
Percent Greater Than 2 Micrograms per Liter
Percent Greater Than 5 Micrograms per Liter
Mean Phenols

151 Y

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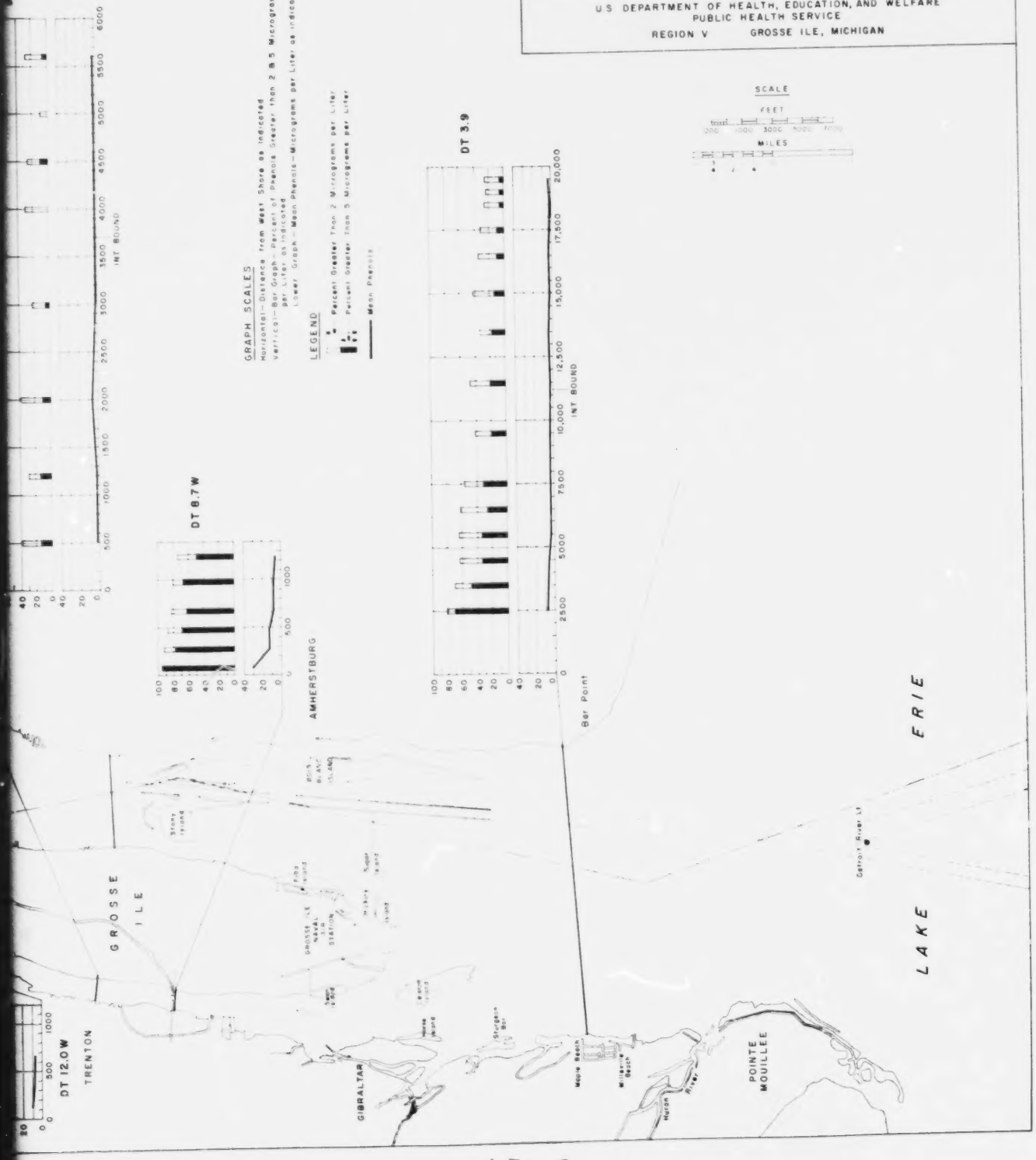
FIGURE 10-V

DETROIT RIVER-LAKE ERIE PROJECT

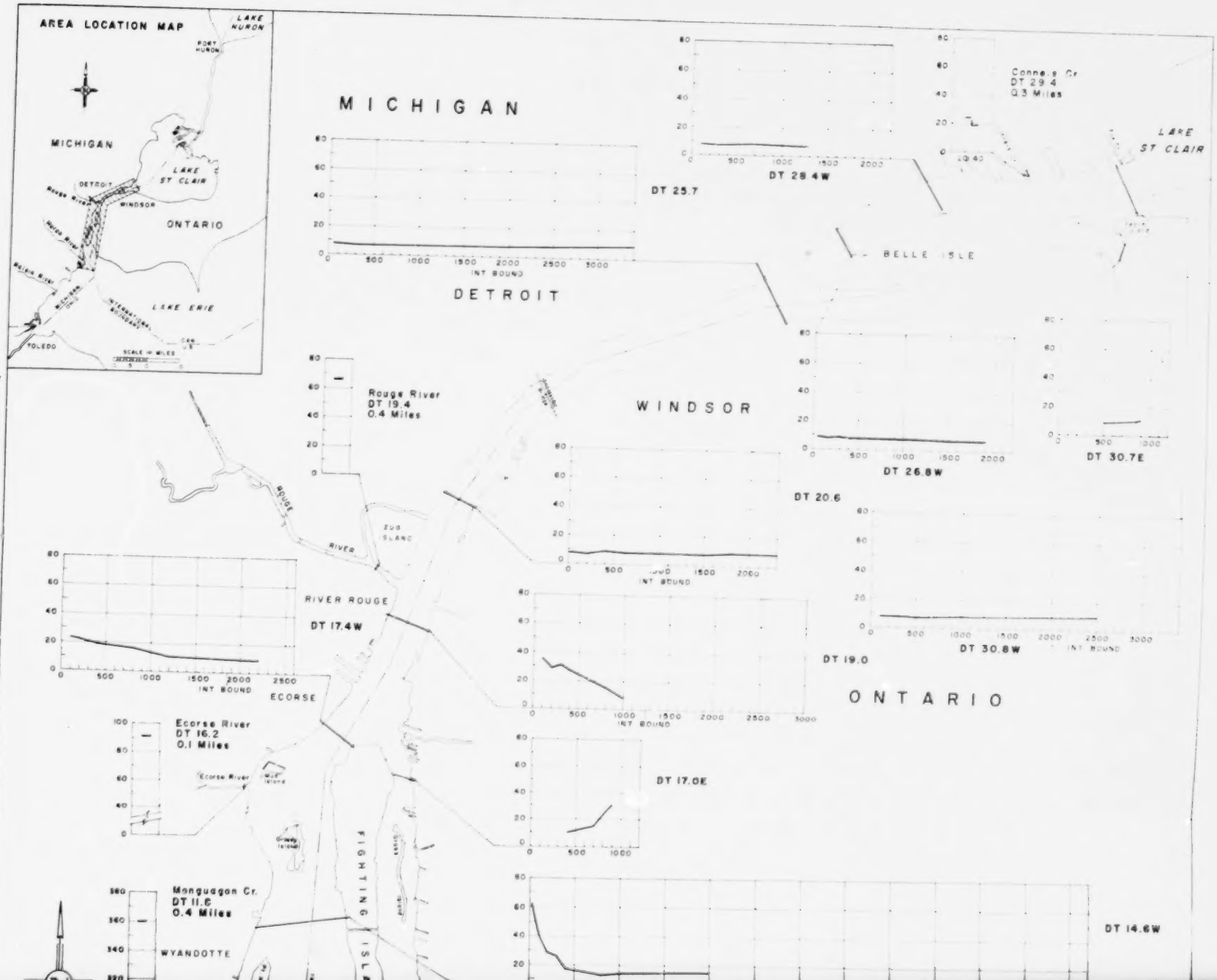
AVERAGE PHENOL CONCENTRATIONS AND PERCENT OF PHENOLS EXCEEDING 2 & 5 µg/l

DETROIT RIVER

U.S. DEPARTMENT OF HEALTH, EDUCATION, AND WELFARE
PUBLIC HEALTH SERVICE
REGION V GROSSE ILE, MICHIGAN

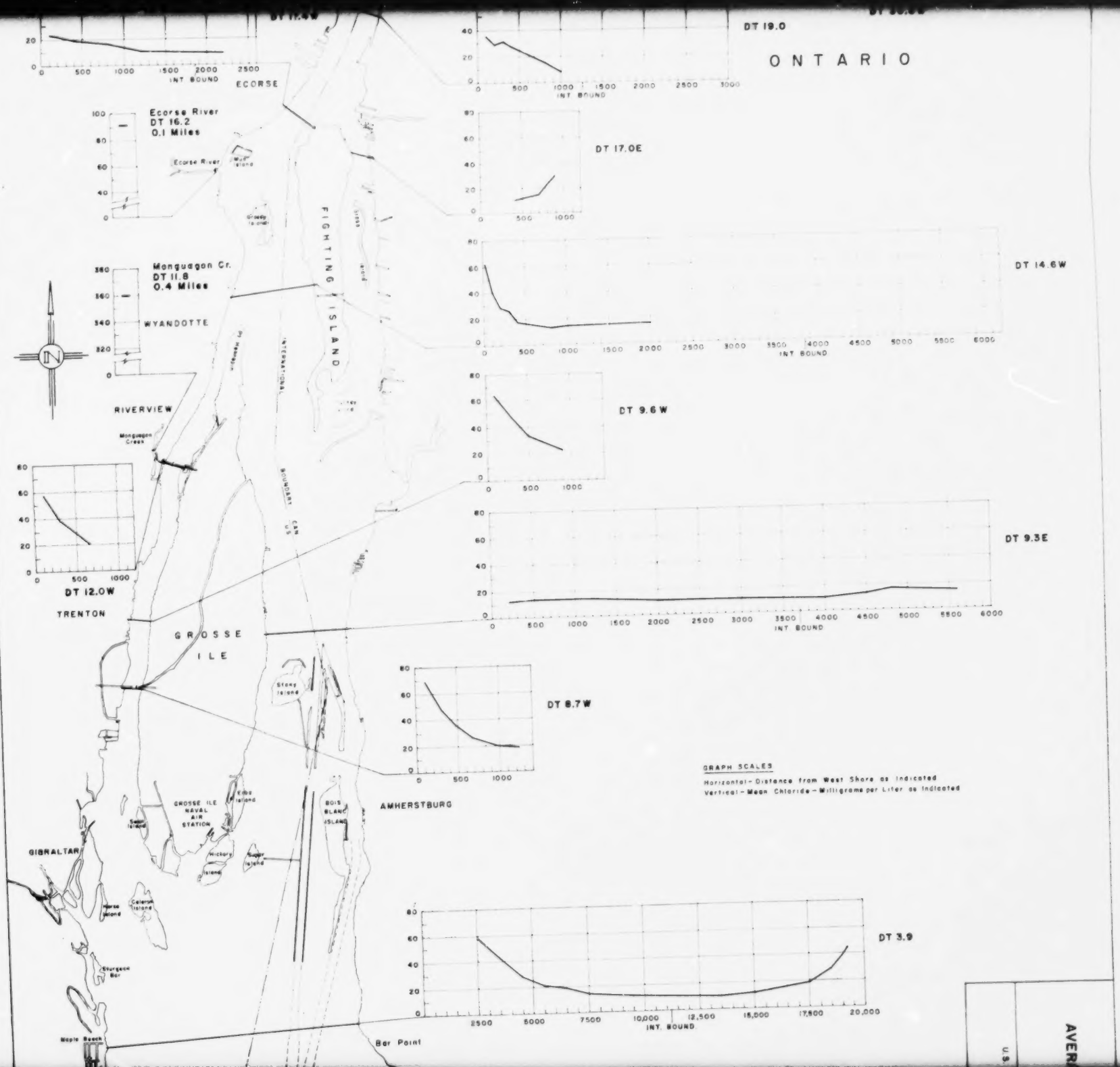


151 C


AREA LOCATION MAP
LAKE HURON
PORT HURON
MICHIGAN
LAKE ST CLAIR
DETROIT
WINDSOR
ONTARIO
LAKE ERIE
TOLEDO
MICHIGAN
DETROIT
WINDSOR
ONTARIO
WYANDOTTE
ECORSE
LAKE ST CLAIR
BELLE ISLE
FIGHTING ISLAND
RIVER ROUGE
DT 25.7
DT 28.4W
Connels Cr
DT 29.4
0.3 Miles
Rouge River
DT 19.4
0.4 Miles
DT 20.6
DT 26.8W
DT 30.7E
DT 19.0
DT 30.8W
DT 17.4W
Ecorse River
DT 16.2
0.1 Miles
DT 17.0E
Monguagon Cr.
DT 11.6
0.4 Miles
DT 14.6W
INT BOUND

151 d

151 e


ONTARIO
ECORSE
Ecorse River
DT 16.2
0.1 Miles
Ecorse River
Mud Island
Grassy Island
Monguagon Cr.
DT 11.8
0.4 Miles
WYANDOTTE
RIVERVIEW
Monguagon Creek
FIGHTING ISLAND
INTERNATIONAL BOUNDARY CAN US
DT 12.0W
TRENTON
GROSSE ILE
Stony Island
GROSSE ILE NAVAL AIR STATION
Elba Island
Sugar Island
Hickory Island
Super Island
BOIS BLANC ISLAND
AMHERSTBURG
GIBRALTAR
Horse Island
Celeron Island
Sturgeon Bar
Maple Beach
Bar Point
DT 19.0
DT 17.0E
DT 14.6W
DT 9.6W
DT 9.3E
DT 8.7W
DT 3.9
INT BOUND
GRAPH SCALES
Horizontal - Distance from West Shore as Indicated
Vertical - Mean Chloride - Milligrams per Liter as Indicated
AVER
U.S.

151 d

151 f

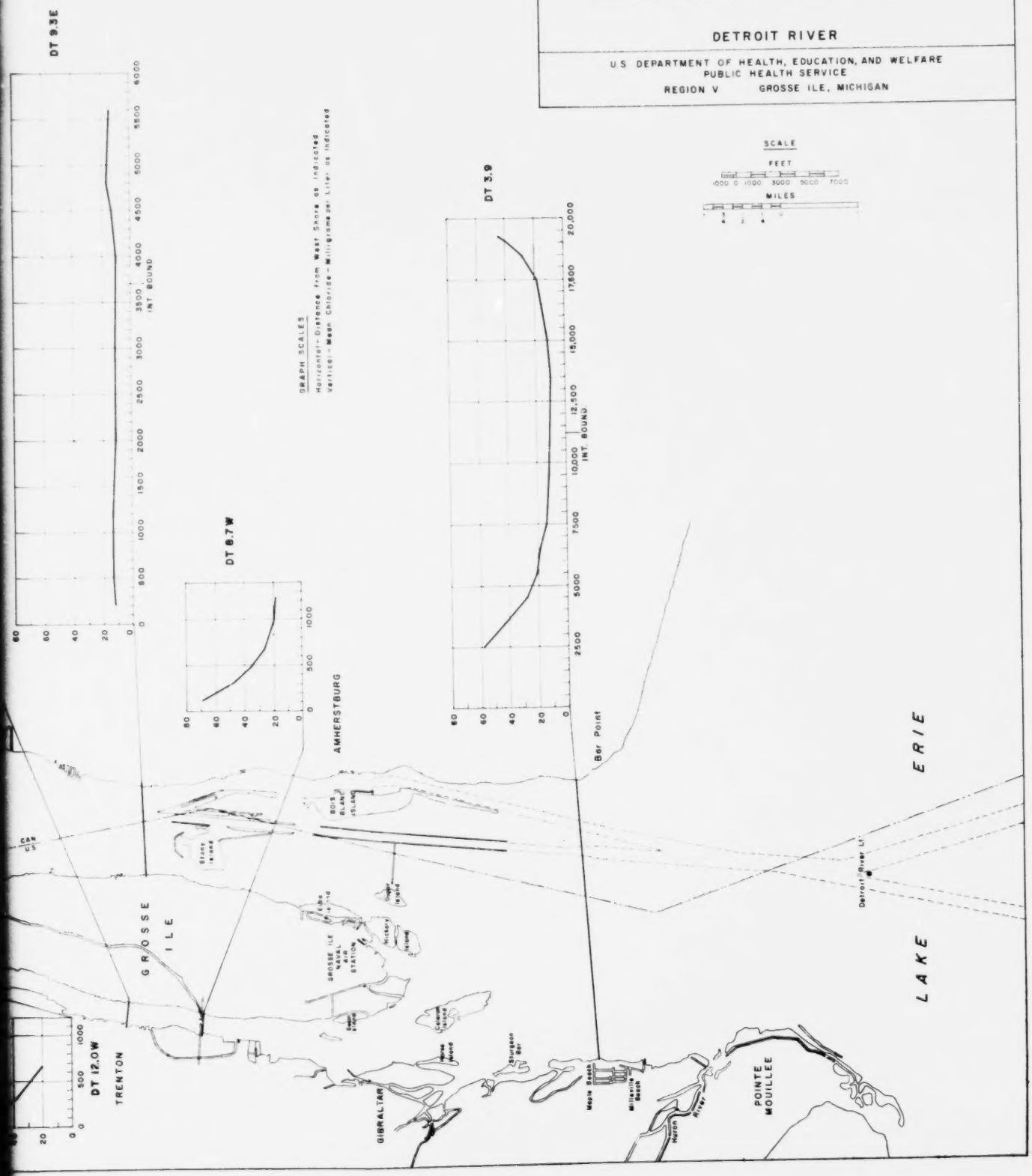
FIGURE II-V

DETROIT RIVER-LAKE ERIE PROJECT

AVERAGE CHLORIDE CONCENTRATIONS

DETROIT RIVER

U.S. DEPARTMENT OF HEALTH, EDUCATION, AND WELFARE
PUBLIC HEALTH SERVICE
REGION V GROSSE ILE, MICHIGAN



151 7

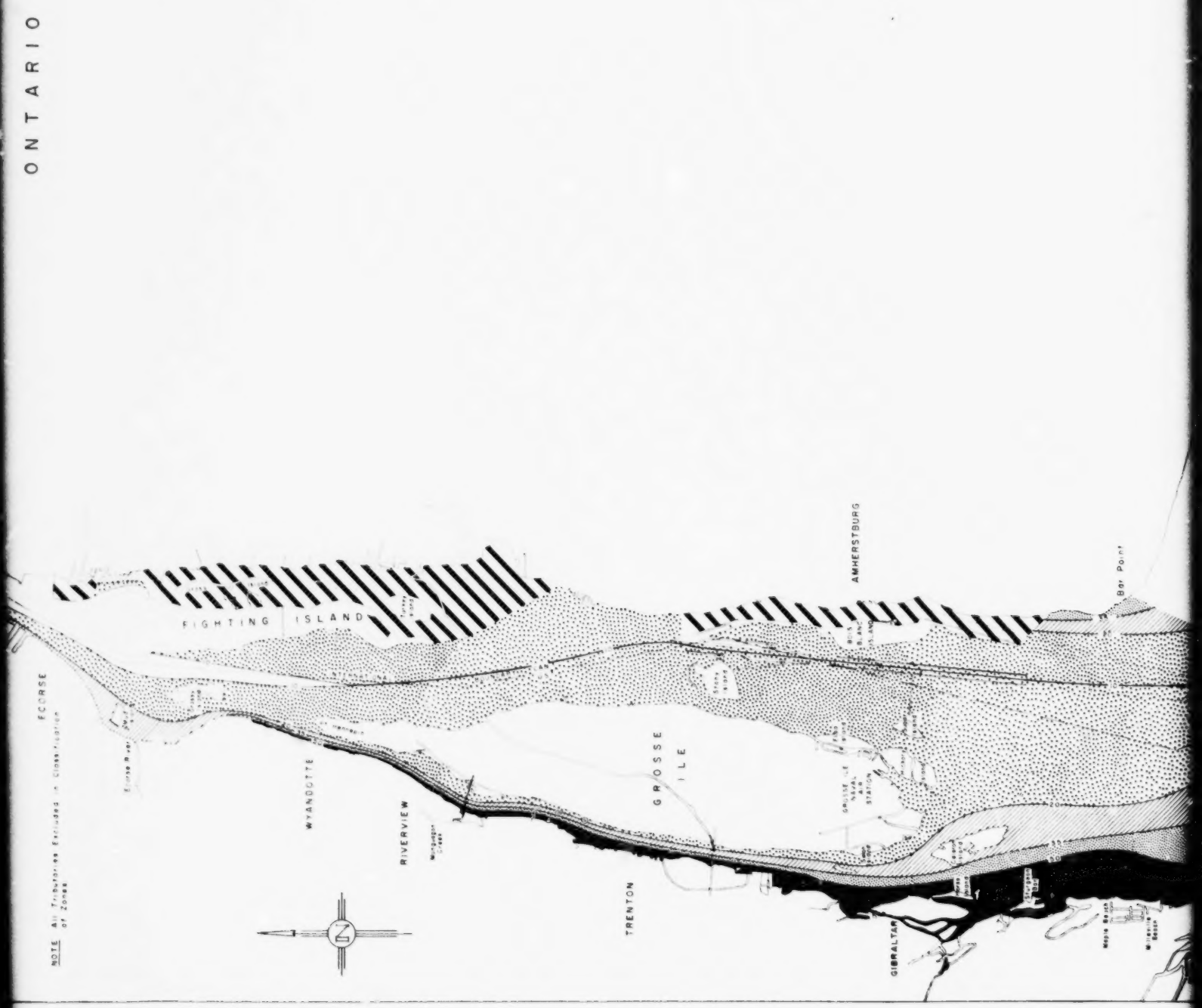
AREA LOCATION MAP
LAKE HURON
PORT HURON
MICHIGAN
LAKE ST CLAIR
DETROIT
Rouge River
WINDSOR
ONTARIO
Huron River
Raisin River
LAKE ERIE
TOLEDO
SCALE IN MILES
MICHIGAN
LAKE ST CLAIR
BELLE ISLE
DETROIT
WINDSOR
ROUGE
RIVER
ZUG ISLAND
RIVER ROUGE
ONTARIO
ECORSE
Ecorse River
FIGHTING
LEGEND
LESS THAN 10 MILLIGRAMS PER LITER
10-20 MILLIGRAMS PER LITER
20-35 MILLIGRAMS PER LITER
35-50 MILLIGRAMS PER LITER
GREATER THAN 50 MILLIGRAMS PER LITER
INSUFFICIENT DATA
NOTE All Tributaries Excluded in Classification of Zones

151 g

151 h

AVERA

US DE



151 h

151 i

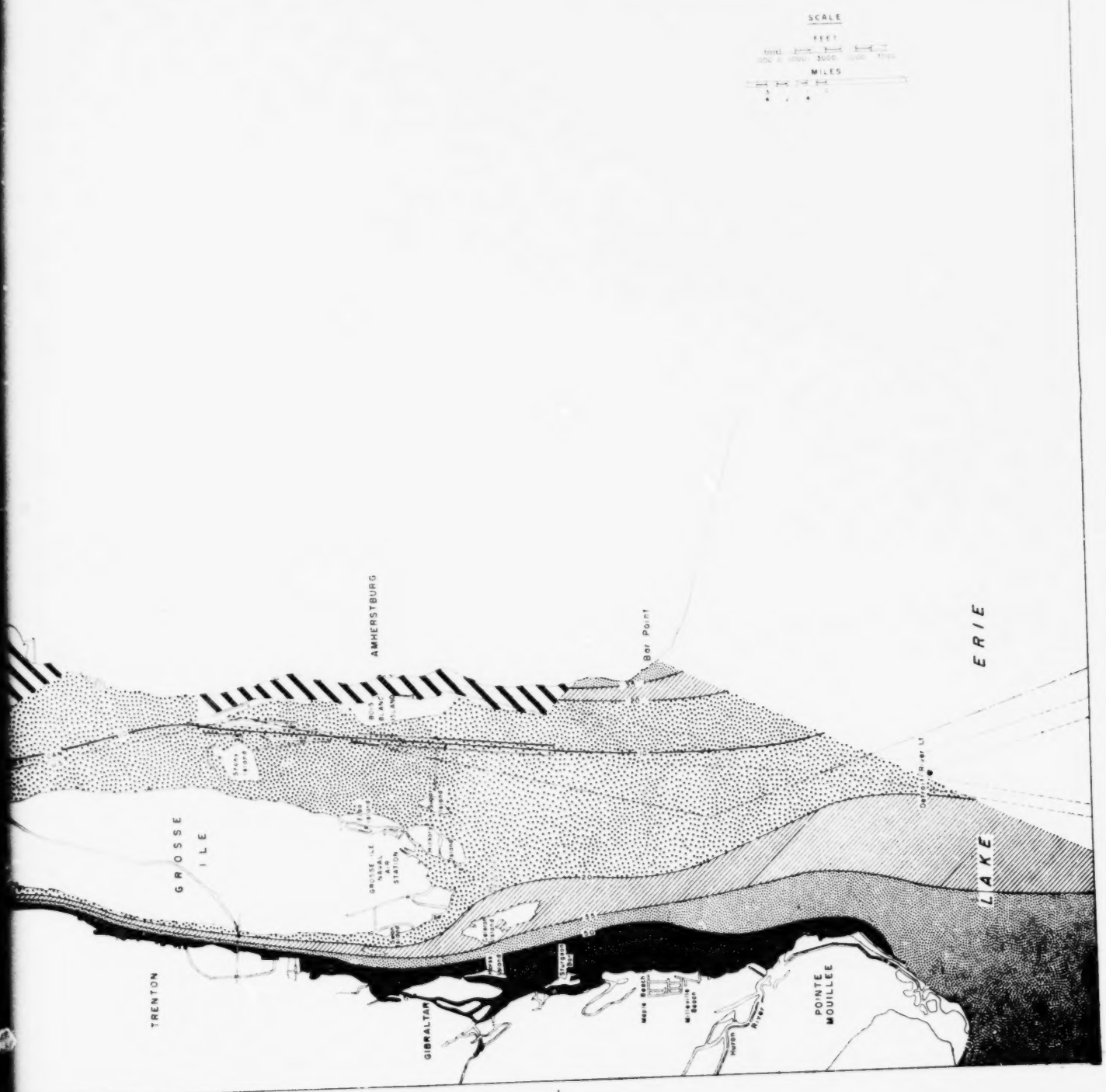
FIGURE 4-V

DETROIT RIVER-LAKE ERIE PROJECT

ZONES OF AVERAGE CHLORIDE CONCENTRATIONS

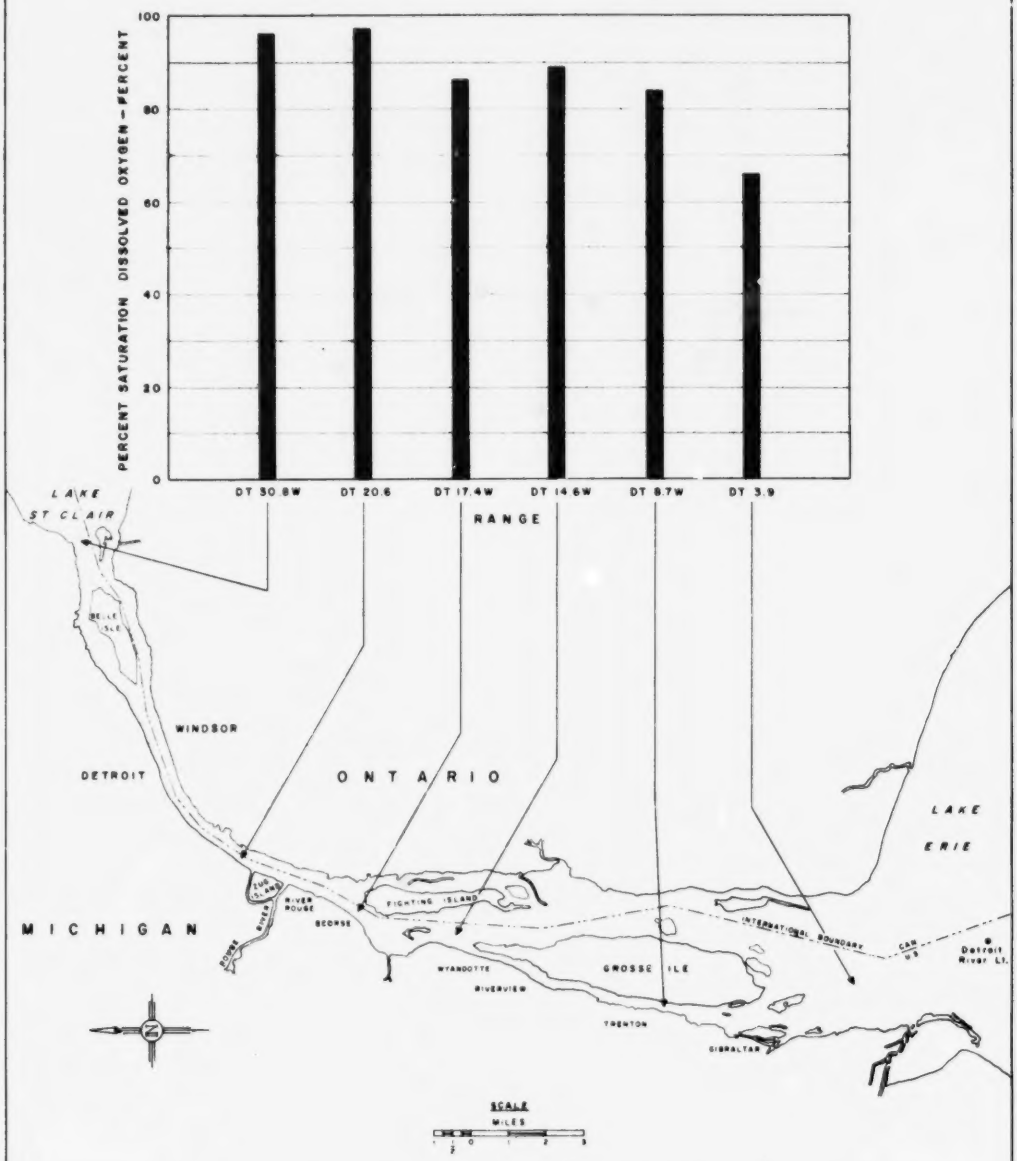
DETROIT RIVER

U.S. DEPARTMENT OF HEALTH, EDUCATION, AND WELFARE
PUBLIC HEALTH SERVICE
REGION V GROSSE ILE, MICHIGAN



151L

FIGURE 12-V



DETROIT RIVER-LAKE ERIE PROJECT

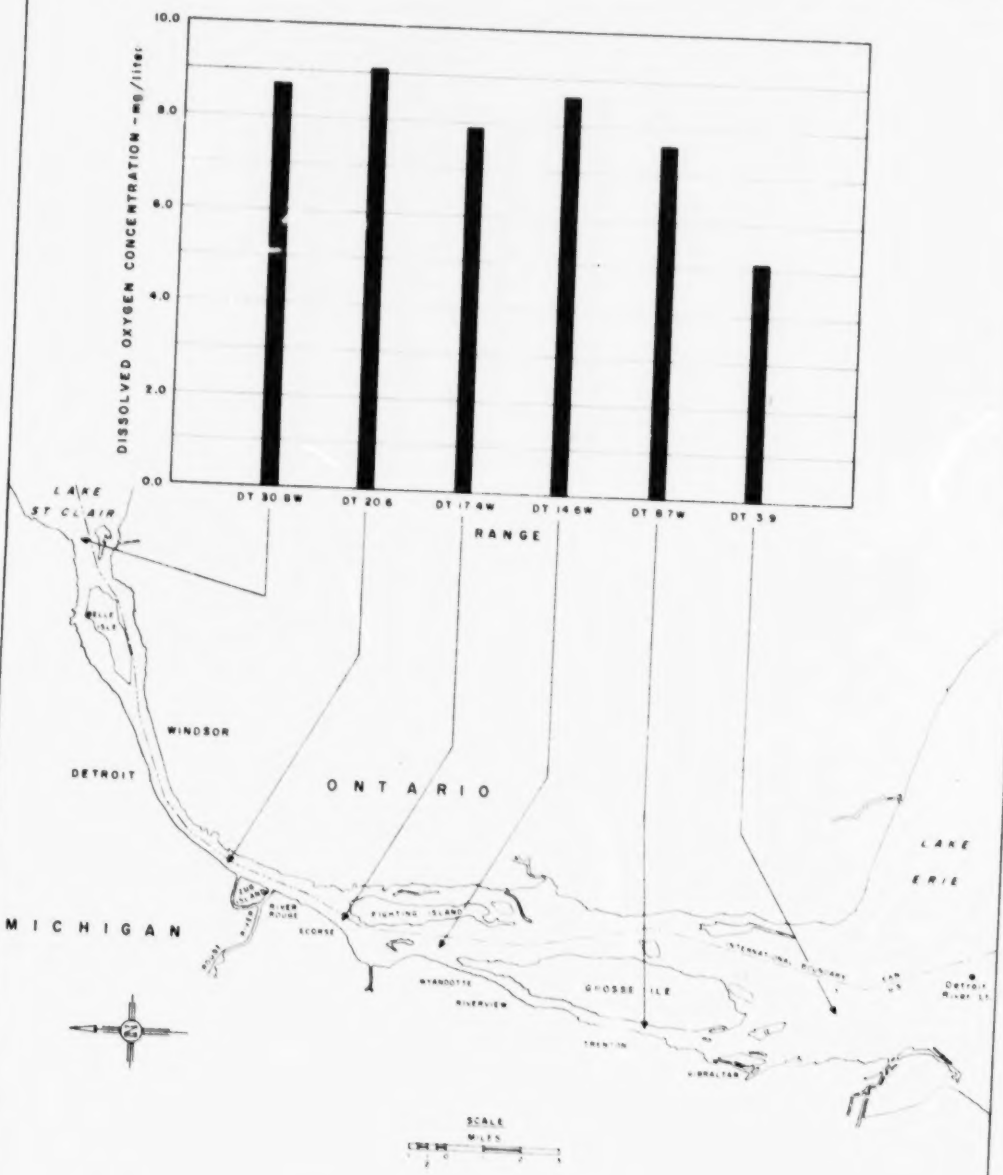
AVERAGE PERCENT SATURATION DISSOLVED OXYGEN

STATION NEAREST U.S. SHORE

DETROIT RIVER

U.S. DEPARTMENT OF HEALTH, EDUCATION, & WELFARE
PUBLIC HEALTH SERVICE
REGION V GROSSE ILE, MICHIGAN

FIGURE 12A-X



DETROIT RIVER-LAKE ERIE PROJECT

MINIMUM DISSOLVED OXYGEN CONCENTRATIONS

STATION NEAREST U.S. SHORE
DETROIT RIVER

U.S. DEPARTMENT OF HEALTH, EDUCATION, & WELFARE
PUBLIC HEALTH SERVICE
REGION V GROSSE ILE, MICHIGAN

From the head of the Detroit River to the Rouge River the average saturation for DO ranged from 93 to 106%. Below the Rouge River saturation decreased to 86 to 97%; at the mouth it further decreased to 67 to 82%. All values observed were in excess of 5 mg/l. Figure 12-V shows the average DO saturation at selected ranges on the Detroit River at stations nearest the United States shore. With the exception of the mouth of the Detroit River (range DT 5.9), the average saturation percentages were relatively constant across each range. Figure 12A-V presents DO values differently, showing minimum concentrations in mg/l at selected ranges during the survey (including 1964 data).

Nitrogen Compounds

Nitrates in drinking water in concentrations greater than 10 mg/l can cause serious illness (methemoglobinemia) in infants. Nitrates also cause interference with many industrial processes. Ammonia can interfere with domestic water treatment by combining with applied chlorine to form chloramines instead of the more effective disinfecting agent, free chlorine. Ammonia in water supplies is usually regarded as evidence of recent pollution from human or animal wastes, if concentrations exceed 0.10 mg/l.

Nitrogen compounds are not present in the Detroit River in concentrations sufficient to cause illness in infants using this supply as drinking water, nor are the existing levels sufficient to cause interference with industrial processes. Average ammonia concentrations as high as 0.41 mg/l could cause water treatment difficulties and necessitate excessive dosages of chlorine to achieve adequate disinfection in domestic water treatment processes.

Nitrogen compounds and phosphates are commonly referred to as essential plant nutrients, or more simply, nutrients. Although only the inorganic forms of nitrogen (nitrates, nitrites, and ammonia) are readily available for plant utilization, other less stable forms can be changed to this available form in the presence of dissolved oxygen and thus are considered in this discussion. All nitrogen compounds are reported as nitrogen.

These compounds coupled with phosphorus can stimulate the growth of alga in bodies of water where other environmental factors are satisfactory. In small quantities alga are desirable as a major source of food for fish. When algal growth exceeds certain limits, nuisances result from undesirable blooms. These are unsightly, can result in obnoxious odors, and can be toxic to fish. A commonly accepted level of inorganic nitrogen compounds (nitrates, nitrites, and ammonia) above which undesirable blooms can be expected to occur is 0.03 mg/l. In the lower section of the Detroit River, especially as it enters Lake Erie, these values are regularly exceeded and pollution from industrial and domestic sources could be expected to cause excessive blooms in the lower river and Lake Erie.

In the upper and lower River, mean nitrate values range from 0.10 to 0.24 mg/l. At the mouth, the range increases to 0.22 - 0.40 mg/l. Nitrites throughout the River are fairly constant at 0.001 - 0.002 mg/l, except at the mouth of the River where the range incraases to 0.003 to 0.011 mg/l. At the head of the Detroit River, mean ammonia nitrogen was 0.08 - 0.14 mg/l. Downstream just above the Rouge River, these values increased to 0.16 - 0.41 mg/l. Below the Rouge River, the mean concentration remained in this range to the mouth. Organic nitrogen throughout the River had mean values between 0.15 and 0.30 mg/l. In the Rouge River, the mean nitrate concentration was 0.39 mg/l with nitrites, ammonia, and organic nitrogen 0.007, 0.51, and 0.16 mg/l respectively.

Phosphates

Soluble phosphates in relatively small concentrations are readily available as an essential plant nutrient. The insoluble portion of the total phosphate concentration can be

converted to the soluble form and thus become available for such plant utilization. Soluble phosphates in concentrations greater than 0.015 mg/l (reported as phosphorus), in combination with inorganic nitrogen compounds in excess of 0.03 mg/l, and accompanied by satisfactory environmental conditions such as light and heat, may produce overabundant growths of algae with unpleasant odors and detriment to fish life.

At the head of the Detroit River total phosphate concentrations averaged 0.03 - 0.30 mg/l. Downstream at a point just above the Rouge River, these values increased to 0.01 - 0.48 mg/l, with the higher values along the United States shore. Below the Rouge River, phosphate mean concentrations continue in this same range until the mouth, where the 3,500 feet nearest the United States shore had mean values of 0.89 - 1.20 mg/l. The remaining section to the international boundary had values of 0.18 - .24 mg/l. Phosphates in the Rouge River averaged 0.18 mg/l, with a maximum value of 0.30 mg/l.

All but two soluble phosphate concentrations in the upper Detroit River were less than 0.001 mg/l, with the highest value located near the United States shore just below the combined sewer outfall at Conners Creek. Below the Rouge River soluble phosphate levels increased to levels ranging from less than 0.001 mg/l to 0.40 mg/l, with the same dispersion pattern apparent. At the mouth soluble phosphates of 0.176 to 0.204 mg/l were found. Throughout the lower River soluble phosphate concentrations exceeded the level at which nuisance algal blooms occur.

pH

Extreme pH values can cause interference with domestic and industrial water supplies by affecting taste, corrosiveness, and the efficiency of chlorination and coagulation processes; interferences with irrigation and fish propagation can also be produced. A drop in pH is experienced in the Detroit River from its head to a point 5 miles below the Rouge River. Average values do not indicate interferences with water use in the Detroit River at this time, but are indicative of significant quantities of acid wastes entering the watercourse.

pH values in the upper Detroit River were uniform, as shown by average values between 8.2 and 8.3. Just below the Rouge River the average pH dropped to 7.6 near the United States shore and to 8.0 away from shore. Approximately 2 miles downstream the average pH dropped again to 7.2 near the United States shore. From this point to the mouth there was a gradual rise in pH until a mean value of 8.0 was reached. The low individual value during the survey was 3.0 at a point approximately 2 miles below the Rouge River at sampling range DT 17.4W.

ABS

Concentrations of ABS (Alkyl Benzene Sulfonate) in excess of 500 μg/l have caused foaming in receiving streams, causing interference with recreational and aesthetic enjoyment of the water and with domestic water treatment processes. Existing levels in the Detroit River are well below this value, but average concentrations in the Trenton Channel have increased to 250 μg/l, indicating potential problems in the future if waste loads increase.

ABS in the upper section of the Detroit River averaged 20 - 40 μg/l. Below the Rouge River, it increased from 30 to 60 μg/l. In the Trenton Channel, these average values increased to 110 to 250 μg/l. At the mouth of the River the average ABS values ranged from 40 to 70 μg/l.

In Conners Creek, ABS averaged 230 μg/l, while the Rouge River averaged 180 μg/l and Monguagon Creek 500 μg/l. The ABS concentration in the tributaries was roughly five times that found in the Detroit River.

Alkalinity

At extreme pH values, alkalinities can cause interference with domestic and industrial water uses, and interference with fish and other aquatic life. The ranges of alkalinity found in the Detroit River do not indicate interference with any water use.

Mean alkalinity concentrations in the entire Detroit River were 68 - 86 mg/l, with no trend evident. Alkalinity values in the tributaries were in this same range with the exception of the Ecorse River, where the average alkalinity was 136 mg/l.

Temperature

Extremely high temperatures can kill fish and cause corrosion problems in water supplies. High temperatures will also accelerate the rate of utilization of the biochemical oxygen demand in the water.

Mean temperature values for the period of the study are meaningless from a practical standpoint because of their extreme dependence upon the season of the year. Study of the year reveals an increase of 2 - 3°C between the head of the Detroit River and a point just above the Trenton Channel. The difference between the head and mouth of the River on any given day was found to be 1 - 2°C, with warmer waters found near the United States shore at the mouth. The highest temperature found in the Detroit River was 28°C, or 82°F, just below the Rouge River.

The Rouge River and Conners Creek were approximately 2 - 5°C warmer than the Detroit River on any given day, while Monguagon Creek was as much as 10°C warmer. The maximum value on any tributary during the survey was 35°C or 95°F in Monguagon Creek.

The 1° - 3°C rise throughout the length of the entire River does not appear to cause any interferences with water use that are not present in the natural state. The temperatures in the River will support all water uses except the propagation of certain cold-water game fish which probably could not survive even the natural temperatures of the upper River.

Chemical Oxygen Demand

Chemical oxygen demand indicates a possible demand on the dissolved oxygen resources of the receiving stream from wastes, usually of an industrial nature, not susceptible to biochemical degradation. The oxygen-consuming strength of these wastes cannot be measured in the BOD determination.

Chemical oxygen demand in the upper Detroit River ranged from mean values of 0 - 9 mg/l. Below the Rouge River this range increased to 28 - 37 mg/l and in the Trenton Channel from 160 - 240 mg/l, with higher values along the west shore. One station at the mouth had average COD values of 30 mg/l.

The significant observed increase in COD in the Detroit River from its head to the lower reaches and particularly the Trenton Channel is indicative of industrial waste discharge. It is difficult to equate COD concentrations in wastes to population equivalents, as is commonly done in BOD wastes, because an unknown amount of the COD concentration actually exerts a demand upon the oxygen resources of the river. The increase does represent the effect of sources of pollution which place some demand upon these resources.

Conductivity

High values of specific conductance indicate excessive mineralization, which can interfere with domestic and industrial water supplies as well as irrigation and fish propagation.

The specific conductance of the Detroit River in its upper section varied between 190 and 220 umhos/cm. Below the Rouge River, the range increased to 220 - 390 umhos/cm, with higher values again along the United States shore. In the Trenton Channel, specific conductance increased to an average value of 500 umhos/cm near the west shore. At the mouth of the River, the range decreased to 240 - 330 umhos/cm.

The values encountered in the Detroit River indicate an approximate twofold increase between the head of the River and a point in the Trenton Channel. These levels do not indicate potential interference with water use in the Detroit River.

Toxic Metals

These metals consist of cadmium, chromium, copper, lead, nickel, and zinc. Toxic metals present a health hazard in drinking water in which they are present in concentrations greater than those listed in the Public Health Service drinking water standards. They can also interfere with industrial processes and act as toxic agents for fish and other aquatic life.

Copper values in all parts of the river except the head averaged less than 0.01 mg/l. At the head of the river, the average was 0.02 mg/l. In over 55 per cent of all samples analyzed, copper was not detected at the 0.01 mg/l level. The maximum value found was 0.11 mg/l.

Nickel averaged 0.01 to 0.02 mg/l throughout the river with a tendency towards higher values near the junction with the Rouge River. The maximum value found was 0.30 in the Trenton Channel with other high values located throughout the length of the river. Over 70 per cent of the samples analyzed showed concentrations greater than 0.01 mg/l.

Zinc was fairly constant, with average values in the range 0.02 to 0.05 mg/l. The maximum value found was 0.60 mg/l in the Trenton Channel. Over 90 per cent of the samples showed concentrations greater than 0.01 mg/l.

Lead was found in average concentrations varying from 0.01 to 0.04 mg/l, with higher values found below the Rouge River and in the Trenton Channel.

Chromium was found in average concentrations of 0.01 mg/l and less, with higher values in the lower Detroit River and especially the Trenton Channel. The maximum value found during the survey was 0.04 mg/l below the Rouge River. Chromium was detected at the 0.01 mg/l level in only 15 per cent of the samples analyzed.

Cadmium was also found in average concentrations less than 0.01 mg/l, with higher values in the Trenton Channel. The maximum value found during the survey was 0.08 mg/l in the channel, while cadmium was detected at the 0.01 mg/l level in only 10 per cent of the samples analyzed.

Toxic metals in Conners Creek were in the same range as the Detroit River and many times in lesser concentrations. Copper was frequently found in significant concentrations in the Rouge River, with one value 0.40 mg/l and a mean value of 0.09 mg/l. Other toxic metals in the Rouge River averaged between 0.01 and 0.02 mg/l. Toxic metals in Monguagon Creek were generally high, with a maximum zinc concentration of 0.56 mg/l.

Other metals showing high values at Monguagon Creek were lead, nickel, and copper, with maximum values of 0.09, 0.05, and 0.04 mg/l respectively.

Average concentrations of copper were less than those expected to interfere with water use but one extreme value at the head of the River indicates a possible toxic hazard to fish and other aquatic life. No other value of similar magnitude was found.

Average and maximum concentrations of nickel, zinc, and chromium found in the Detroit River do not indicate interference with water use.

Average values of lead approached levels of 0.05 mg/l, which represent a threat to the health and welfare of consumers of domestic water supplies. The maximum value encountered approaches the limit of 0.10 mg/l, which represents a potential threat to fish and other aquatic life. Further increases in any magnitude of waste loadings to the Detroit River containing lead may represent a threat to the health and welfare of the users of the lower Detroit River and to fish life in that reach of the River.

Average cadmium values indicated no interference with domestic water use or propagation of fish and other aquatic life. A maximum value of 0.08 mg/l did exceed recommended limits for these uses, and careful surveillance should be made of future levels of this substance.

High levels of copper and lead were found in the Rouge River and Monguagon Creek.

Oil and Grease

Analysis for oil and grease was not made on River or Lake samples due to difficulty in obtaining a representative sample. Observations were made of visible floating oil, which for the most part was noticed in marinas and other areas of shallow or slow moving water. Remedial measures to abate oil and grease pollution should be made with the objective of keeping effluents from all wastes as low as practicable. IJC effluent recommendations of not more than 15 ppm oil and grease in the effluent appear to be applicable in this instance.

Cyanide

Cyanides are toxic to man as well as fish and other aquatic life. PHS drinking water standards recommend limiting cyanide concentrations to 0.01 mg/l. Cyanide concentrations above 0.025 mg/l are considered detrimental to fish and other aquatic life. A mandatory limit of 0.20 mg/l has been set for cyanide concentrations in drinking water by the PHS standards.

In the upper Detroit River, cyanides were present in 15 per cent of the samples analyzed, with a maximum concentration of 0.01 mg/l. In the lower River above the Trenton Channel, cyanides were found in 21 per cent of the samples analyzed equal to or in excess of 0.01 mg/l, with one value 0.05 mg/l. In the Trenton Channel cyanides were found in 18 per cent of the samples equal to or in excess of 0.01 mg/l, with a maximum value of 0.03 mg/l. At the mouth of the Detroit River, 35 per cent of all samples analyzed contained cyanides equal to or in excess of 0.01 mg/l, with a maximum value of 0.09 mg/l, 7,500 feet from the United States shore.

Cyanide concentrations found in the lower Detroit River pose a potential interference with domestic water supply and fish and wildlife propagation.

Hardness

Hardness in the Detroit River increased from approximately 100 mg/l at the head of the river to 130 mg/l near the mouth. Hardness in the raw water supply at the City of Monroe intake in Lake Erie has averaged 128 mg/l over the past few years. This increase is due to the discharge of industrial and municipal wastes containing calcium and magnesium. Hardness interferes with municipal water supplies by increasing the amount of soap and detergent required for household use.

Biological

Microscopic Plants and Animals

Phytoplankton, free-floating microscopic plants, are of basic importance in aquatic environments since they provide the first step in the food chain of fishes. By the process of photosynthesis, phytoplankton are able to synthesize protoplasm from the nutrients available in the waters, utilizing sunlight for energy. Zooplankton, the animal plankton, form the food of many young fishes at the critical post-hatching period. The microcrustacean plankters are important animals in the transformation of algal cell material into fish flesh. As primary consumers, they feed upon the phytoplankton. In order to support game fish at the top of the food chain pyramid, the waters must produce large quantities of zooplankton.

Plankton in excessive numbers can create nuisances. Some species may become toxic. Many cause water treatment problems by clogging filter beds and producing tastes and odors. Through the uptake of nutrients released to the waters by domestic wastes, industrial waters, and land drainage, algae can occur in such abundance as to accelerate significantly the aging of lakes.

Low oxygen-producing potentials in the lower water strata and the mud-water interface of lakes create acid conditions that liberate nutrients bound in the mud-water interface region to overlying waters. These phosphates further contribute to nuisance blooms and augment algae problems.

In addition to studies of free-floating plants and animals, attached slimes and other microscopic organisms were collected from numerous points in the Detroit River and Lake Erie and examined (see Figure 11-VI). Many of these organisms form massive colonies in organically enriched and highly polluted waters. One such species is Sphaerotilus, a filamentous slime bacterium, commonly referred to as "sewage fungus", one of the most unsightly products of pollution. These bacteria form ragged white, yellow, pink, or brown masses on all solid objects in rivers and lakes and may even form a carpet over mud surfaces. At times, drifting masses of sewage fungus may continue to grow in open waters of large rivers and cause trouble to fishermen by fouling lines and nets. Another growth, the filamentous green algae Cladophora, may also be associated with polluted and nutrient-enriched waters. When dead and windrowed upon beaches, it decays and produces obnoxious odors and may become a fly-breeding habitat. Abundant growths of this algae may become a nuisance on beaches, prohibit swimming, and interfere with recreation.

The Detroit River from head to mouth was found to contain low numbers of planktonic algae, counts ranging from 50/ml to 4,675/ml and averaging 500/ml. Low concentrations of animal plankton were also found.

Plankton entering the River from Lake St. Clair were carried as a "standing crop" down the River to its mouth with little change in density or species composition either vertically (in depth) or horizontally (across the River). The rate of travel of the population down the 27-mile stretch of the waterway is too rapid for the domestic and industrial wastes to appreciably alter the numbers of plankton. Diatoms, silica-walled alga (brown or greenish in color), usually made up 70 per cent or more of the phytoplankton populations.

The early spring diatom pulse in Lake St. Clair raises the counts in the Detroit River to levels averaging 2,000/ml. At that time, diatoms have reported to cause trouble at the Detroit filter plant by reducing filter runs and increasing coagulation costs.

The observed turbid condition of the Detroit River was not associated with the concentration of living organisms in the waters since plankton populations were not dense enough to contribute appreciably to turbidity. Rather the cause of the turbid water is

attributable to a combination of the fine clay particles carried in suspension from the water masses from Lake St. Clair, and inorganic and organic particulate matter from industrial and domestic wastes of the Detroit area.

The sewage fungus, Sphaerotilus, was found growing attached to bridge abutments, pilings, piers, buoys, and slide racks suspended in the waters to capture these organisms. It was abundant in the Detroit River below the Rouge River and Detroit Sewage Treatment Plant outfall (Figure 13-V). The growth of these slime bacteria was caused by the discharge of inadequately treated municipal and industrial wastes of organic origin in the Detroit Area.

Bottom Organisms

As the environment in which bottom organisms live becomes modified by pollution, undesirable changes occur in the kinds and numbers of organisms present. Bottom-dwelling organisms do not move great distances and therefore are subjected to all local environmental changes. As a community of organisms becomes upset by pollution, some species abound in disproportionate numbers. Huge aggregations of only one kind of organism may be present. Deposition of fine silt or flocculent ooze from decaying organic matter of industrial and domestic origin constitutes one of the greatest hazards to most species of clean-water associated bottom-dwelling organisms. Oils and greases which are absorbed into the bottom muds are another source of disruption.

Based on their response to pollution, bottom dwellers can be separated into three categories: pollution-sensitive, intermediate, and pollution-tolerant organisms. Pollution-sensitive forms, such as mayflies, caddisflies, and mussels, are associated with clean-water habitats and are important because they provide essential food for many game fishes. Intermediate forms, such as snails, fingernail clams, and scuds, are capable of surviving in a moderately polluted environment. Pollution-tolerant forms, such as sludgeworms, bloodworms, and leeches, may survive in areas severely polluted with organic wastes. The elimination of sensitive organisms and the seemingly unlimited food supply from organic solids permit the surviving tolerant forms to increase inordinately in numbers.

Under conditions of drastic pollution even the tolerant forms may be destroyed and no signs of life will be apparent in the bottom muds. Consequently, the presence or absence of certain bottom organisms in a sample becomes meaningful and enables a trained observer to assess the quality of the water passing over the organisms.

Bottom samples in the Detroit River were collected at various locations during the spring, summer, and fall seasons of 1963.

Bottom samples collected at the headwaters down to the northern tip of Belle Isle contained a pollution-sensitive association of organisms (Figure 14-V and Table 4-V). Environmental conditions and the character of the substrata were ideal for the presence of a variety of clean-water associated species. The water in this reach of the River was not degraded.

A short distance downstream from Belle Isle (Figure 14-V), bottom samples collected near the Michigan shore did not contain sensitive or even intermediate forms; only a preponderance of pollution-tolerant sludgeworms and leeches thrived. Below the combined sewer outlets at Conners Creek, along the Michigan shoreline downstream to Zug Island, clusters of sludgeworms inhabited the entire stretch of the bottom sludges. This reflects the addition and settling of organic material of sewage origin from the combined sewer overflows of the City of Detroit. In contrast, the midstream floor of the River contained many sensitive clean-water associated animals and was similar to the character of the area upstream from Belle Isle.

The reach of the River from Zug Island downstream to the mouth was polluted as indicated by the disappearance of sensitive organisms and the predominance of intermediate and tolerant forms Habitats suitable to support a variety of bottom organisms have been destroyed by the deposition of organic solids and oils, especially in areas nearest the Michigan shore.

Three distinct areas of severely polluted waters were evident (Figure 14-V). One area was located along the Michigan shoreline, opposite the communities of Ecorse and River Rouge, downstream from the effluent of the Detroit Sewage Treatment Plant and the confluence of the severely polluted Rouge River. Only tolerant leeches and sludgeworms were found. Sludgeworms occurred in numbers as great as 24,000 per square foot. Field personnel found the bottom composed of ooze, sludge, many sludgeworms, with the appearance and odor of crankcase oil and sewage odor. Another area was confined to the reach downstream from the Wayne County Sewage Treatment Plant along the Riverview shorefront, where sludgeworms were found in numbers of 15,000 per square foot. Field personnel found muck, sludge, nauseating heavy oil odor, sludgeworms, dead snail shells and clam shells anchored in gray clay. The third area occurred where the Detroit River enters Lake Erie east of Pointe Mouillee. As the velocity of flow is reduced, suspended organic solids settle to the bottom, forming thick sludges that support sludgeworm populations of 5,800 per square foot.

Clinging mayfly nymphs, pollution-sensitive organisms normally occurring with clean-water bottom organisms associations on stony bottom, inhabited the upper ranges of the river. Burrowing mayfly nymphs, another sensitive form which lives in mud, were collected opposite the western side of Belle Isle. Below the Rouge River and the Detroit Sewage Treatment Plant outfall, dredge hauls from soft bottoms in habitats once thriving with burrowing mayfly nymphs did not yield even a single specimen either in the river or lake. Habitats suitable for the support of this once abundant organism have been totally destroyed by pollution.

Evaluation of the bottom fauna in the Detroit River from its headwaters to its mouth shows a change from a community of clean-water associated organisms above significant sources of pollution to a community of predominantly pollution-tolerant organisms below known sources of pollution. Pollution from industrial and domestic sources causes this significant change in population composition, and damages habitats for desirable bottom-dwelling organisms.

AREA LOCATION MAP
LAKE HURON
PORT HURON
MICHIGAN
LAKE ST CLAIR
DETROIT
WINDSOR
ONTARIO
LAKE ERIE
TOLEDO
MICHIGAN
DETROIT
WINDSOR
LAKE ST CLAIR
BELLE ISLE
ROUGE
RIVER
ZUG ISLAND
RIVER ROUGE
ECORSE
ONTARIO
LEGEND
AREA WHERE FILAMENTOUS SEWAGE BACTERIA WERE OBSERVED

161 a

ONTARIO
RIVER ROUGE
ECORSE
Ecorse River
Mud Island
Grassy Island
FIGHTING ISLAND
WYANDOTTE
INTERNATIONAL
RIVERVIEW
Turkey Island
Monguagon Creek
BOUNDARY
CAN
U.S.
TRENTON
GROSSE ILE
Stony Island
GROSSE ILE NAVAL AIR STATION
Fibo Island
Sugar Island
BOIS BLANC ISLAND
AMHERSTBURG
GIBRALTAR
Hickory Island
Horse Island
Celeron Island
Sturgeon Bar

1612

FIGURE 13-V

DETROIT RIVER-LAKE ERIE PROJECT

DISTRIBUTION OF FILAMENTOUS SEWAGE BACTERIA

U.S. WATERS

DETROIT RIVER

U.S. DEPARTMENT OF HEALTH, EDUCATION, AND WELFARE
PUBLIC HEALTH SERVICE
REGION V GROSSE ILE, MICHIGAN

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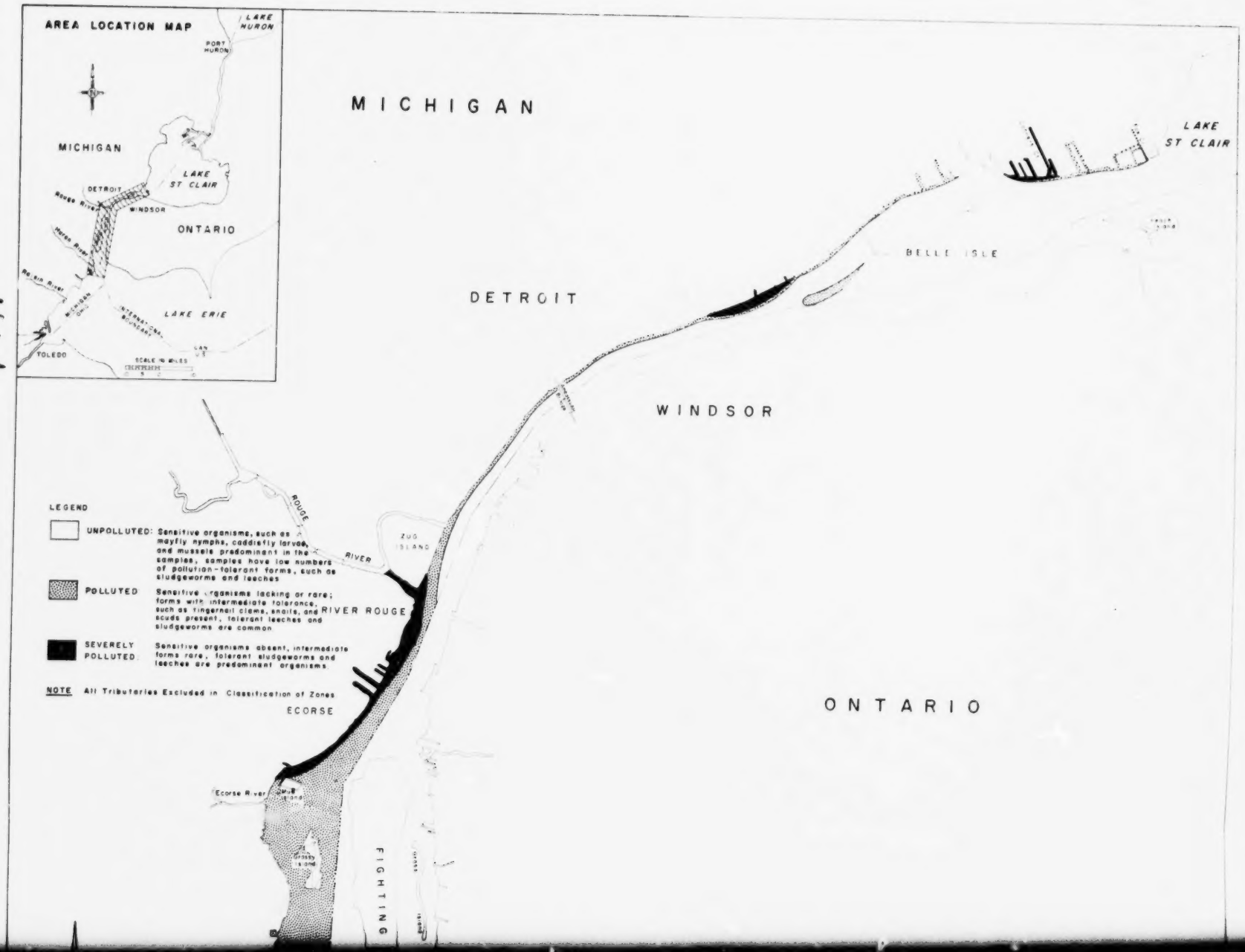
AREA LOCATION MAP
LAKE HURON
PORT HURON
MICHIGAN
LAKE ST CLAIR
DETROIT
Rouge River
WINDSOR
ONTARIO
Huron River
Raisin River
LAKE ERIE
TOLEDO
MICHIGAN
DETROIT
WINDSOR
ONTARIO
LAKE ST CLAIR
BELLE ISLE
ROUGE
RIVER
ZUG ISLAND
RIVER ROUGE
ECORSE
Ecorse River
FIGHTING
LEGEND
UNPOLLUTED: Sensitive organisms, such as mayfly nymphs, caddisfly larvae, and mussels predominant in the samples, samples have low numbers of pollution-tolerant forms, such as sludgeworms and leeches
POLLUTED Sensitive organisms lacking or rare; forms with intermediate tolerance, such as fingernail clams, snails, and scuds present, tolerant leeches and sludgeworms are common
SEVERELY POLLUTED Sensitive organisms absent, intermediate forms rare, tolerant sludgeworms and leeches are predominant organisms
NOTE All Tributaries Excluded in Classification of Zones

Fig 8

sauds present; tolerant leeches and sludgeworms are common
SEVERELY POLLUTED
Sensitive organisms absent, intermediate forms rare, tolerant sludgeworms and leeches are predominant organisms
NOTE All Tributaries Excluded in Classification of Zones
ECORSE
ONTARIO
Ecorse River
Mud Island
Grassy Island
FIGHTING ISLAND
WYANDOTTE
Pt. Hennepin
INTERNATIONAL BOUNDARY CAN
Turkey Island
RIVERVIEW
Monguagon Creek
TRENTON
GROSSE ILE
Stony Island
GROSSE ILE NAVAL AIR STATION
Elba Island
Swan Island
HOIS BLANC ISLAND
AMHERSTBURG
GIBRALTAR
Hickory Island
Sugar Island
Horse Island
Celeron Island
Sturgeon Bar

161 e

FIGURE 14-V

DETROIT RIVER-LAKE ERIE PROJECT

AREAS OF POLLUTION AS INDICATED BY BOTTOM ORGANISM ASSOCIATIONS

U.S. WATERS
DETROIT RIVER

U.S. DEPARTMENT OF HEALTH, EDUCATION, AND WELFARE
PUBLIC HEALTH SERVICE
REGION V GROSSE ILE, MICHIGAN

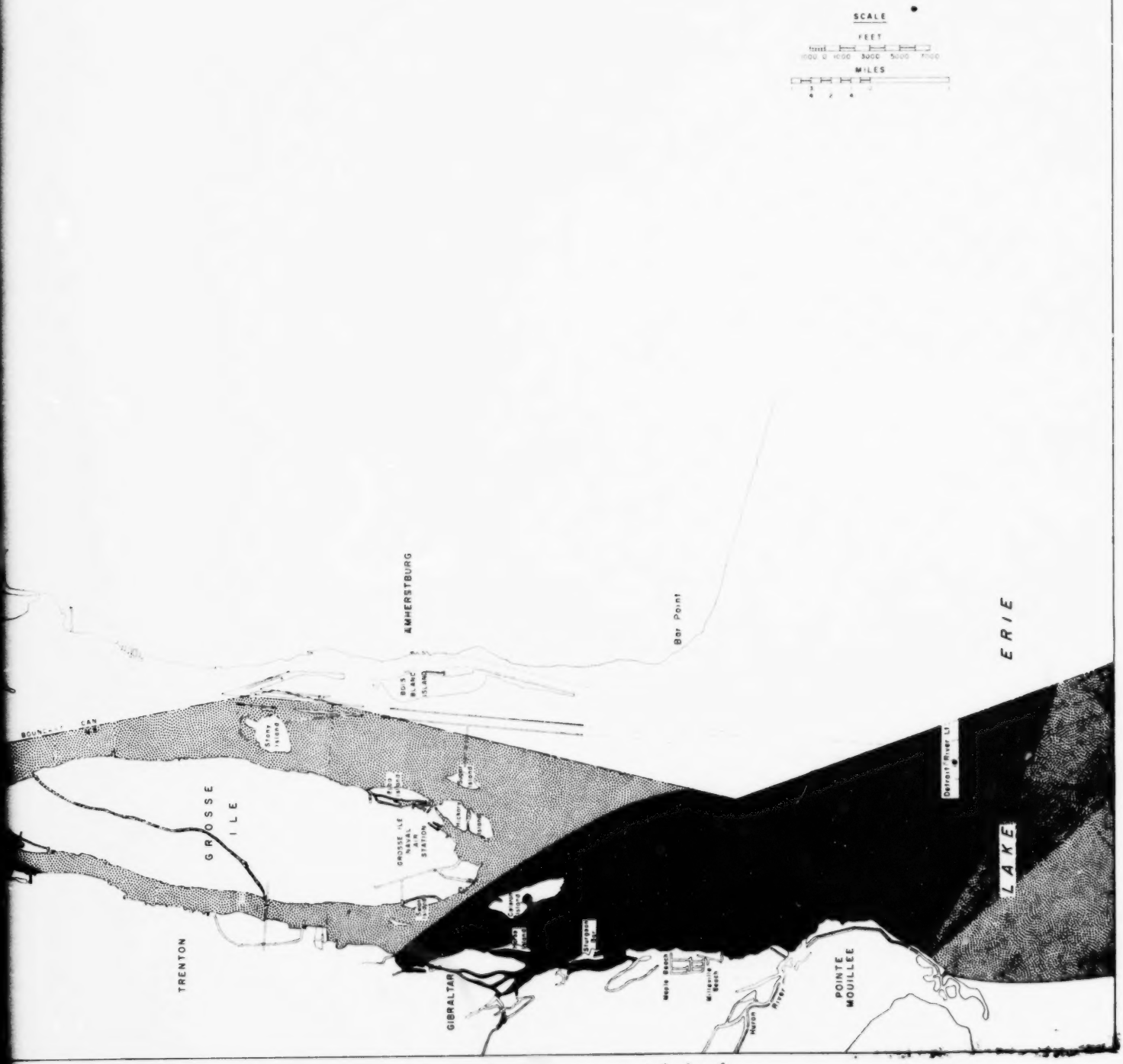

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TABLE 4-V. SUMMARY OF BOTTOM ORGANISM DATA, DETROIT RIVER

MEAN NUMBER PER SQUARE FOOT OF BOTTOM

		SENSITIVE FORMS			INTERMEDIATE FORMS				TOLERANT FORMS	
Detroit River Mile	Range	Caddisfly Larvae	Mayfly Naiads	Mussles	Snails	Fingernail Clams	Scuds	Midge Larvae	Leeches	Sludgeworms
30.8	R-98	17	1	1	2	1	2	2	1	2
	R-104	1	1	-	1	1	-	1	-	-
	R-106	30	1	1	2	3	1	1	-	1
28.4	R-114	11	-	1	-	1	1	-	-	4
	R-118	2	-	1	3	56	1	-	1	3
	R-120	3	1	1	3	16	1	1	-	1
25.7	R-122	-	-	-	-	-	-	-	1	206
	R-125	1	-	1	6	82	1	1	-	1
20.6	R-3	1	-	-	1	2	1	-	3	79
	R-7	4	1	1	2	15	1	1	-	-
	R-11	1	-	-	1	7	1	1	-	-
19.0	R-139	-	-	-	-	-	-	-	-	48
	R-141	-	-	-	-	-	-	-	-	12
	R-143	-	-	-	-	11	-	6	-	11
17.4	R-17	-	-	-	-	1	-	-	2	24,400
	R-21	1	-	-	1	2	1	-	1	31
	R-25(1)	1	-	-	-	-	-	-	-	-
14.6	R-32	1	-	-	1	3	-	-	4	62
	R-40	-	-	-	2	1	-	-	1	1
	R-44(2)	1	-	-	-	-	-	1	1	1

TABLE 4-V – Continued

Detroit River Mile	Range	Caddisfly Larvae	Mayfly Naiads	Mussels	Snails	Fingernail Clams	Scuds	Midge Larvae	Leeches	Sludgeworms
12.0	R-86	-	-	-	-	-	-	2	1	15,500
	R-89	-	-	-	1	-	-	-	1	24
9.3	R-46	-	-	-	3	-	1	1	1	17
	R-50	-	-	-	2	-	1	-	1	38
	R-54	-	-	-	1	1	-	-	1	2
8.7	R-91	1	-	-	19	2	1	-	13	2
	R-94	-	-	-	1	1	-	2	1	372
	R-96	1	-	-	2	1	-	-	1	-
3.9	R-66	-	-	-	8	-	-	1	1	148
	R-69	-	-	-	3	1	-	1	1	1,134
	R-73	-	-	-	2	4	-	-	3	116
Rouge River		-	-	-	-	-	-	-	-	9,520

(1) No macro-bottom organisms, Summer Survey.
(2) No macro-bottom organisms, Spring Survey.

Trends in Water Quality

One approach to evaluating trends in water quality and pollution abatement is to compare existing water quality levels and waste discharges with those found during past surveys. Figures 15-V, 16-V, and 17-V compare levels of total coliform organisms, phenols, and chlorides found during this Project with those found during the 1946-48 IJC survey.

In United States waters, particularly near the shore, there has been an improvement in water quality as measured by total coliform organisms, except at the head of the River, where satisfactory water quality was found during both surveys.

Figure 16-V, depicting phenols, shows little change at the head of the Detroit River. At downstream ranges the values adjacent to the United States shore were considerably lower during the 1963 period, while phenol concentrations away from this shore were higher during this period. At the mouth there was a slight improvement in water quality as determined by average phenol concentrations in United States waters.

Figure 17-V shows mean chloride concentrations during the two surveys. Little change in chloride concentrations in the upper Detroit River was noted. In the lower River, chloride concentrations during the 1946-48 IJC survey were higher near the United States shore, while offshore values were higher during the 1962-63 survey. The reverse situation occurred at the mouth. Generally speaking, very little change in chloride concentrations occurred between the two surveys.

Table 5-V compares waste loadings found during the IJC and PHS surveys for selected measures of water quality. The 1946-48 loadings represent industrial sources only, while 1962-63 results are given for industrial and domestic sources. Comparison of industrial waste loadings reveals a substantial reduction during the intervening 15 years in all five measures of water quality considered. A 22% reduction in ammonia and 51% reduction in suspended solids industrial wastes loadings are shown while reduction of phenols, oil and grease, and cyanides exceeded 70%.

Domestic waste loadings for these waste constituents were not available in the 1946-48 IJC report. Table 5-V indicates large amounts of all constituents (except cyanides) in the domestic waste sources studied in the 1962-63 survey. Even though real progress has been made in reducing industrial waste loadings in the area, concentrations of these constituents in the River will not be substantially lowered until both industrial and domestic waste sources are reduced.

Another approach to evaluation of trends in water quality is the study of changes in levels of certain measures of water quality during this survey. Figures 18-V, 19-V, and 20-V compare 1962 average values for total coliform organisms, phenols, and chlorides with 1963 values.

Figure 18-V, depicting geometric mean total coliform values for the two years, shows significantly lower coliform values in the Detroit River during 1963 than 1962 in United States waters (especially near the United States shore). Phenol concentrations in the Detroit River (shown in Figure 19-V) were consistently higher in 1963 than 1962. Chloride concentrations in the lower Detroit River were higher in 1963 except at the mouth, where they were lower near the United States shore and higher on the Canadian. There was very little change in chloride concentrations in the upper Detroit River in the two years.

Comparison of the Rouge River findings during these two years shows a decrease in average total coliform densities and phenols in 1963 and no change in chloride concentrations during this period.

TABLE 5 - V

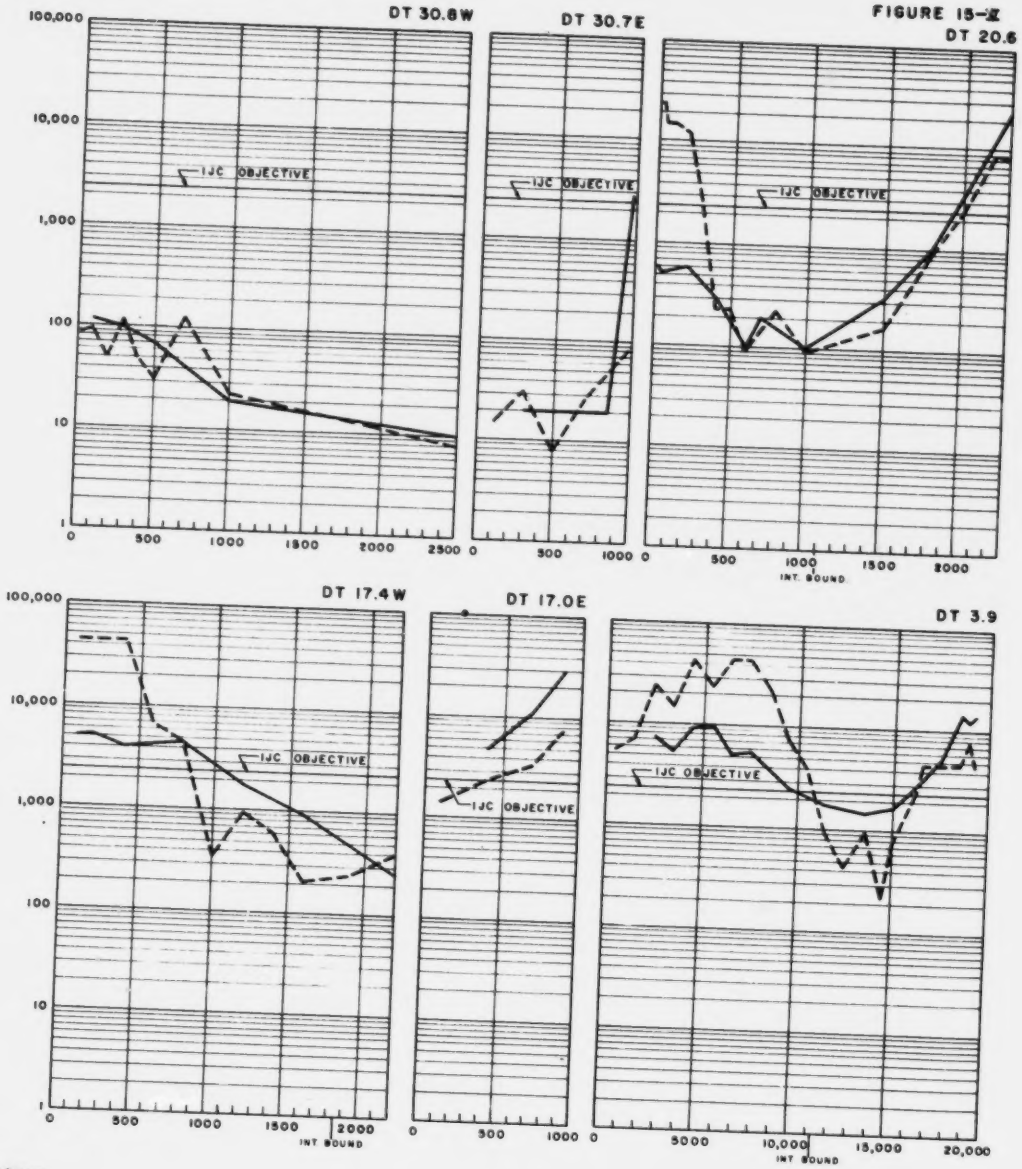
SUMMARY OF WASTE LOADINGS FOUND DURING INTERNATIONAL JOINT COMMISSION AND PUBLIC HEALTH SURVEYS

DETROIT RIVER - UNITED STATES SIDE

Survey	Source	Total Waste Flow (MGD)	Phenols (lbs)	Cyanides (lbs)	Ammonia (lbs)	Oils (gallons)	Suspended Sol. (lbs)
1946-48 IJC	Industrial	1,173*	4,890	3,690	11,010	16,240	1,669,200
1962-63 PHS	Industrial	1,090	1,410	1,030	8,530	3,350	822,000
% Reduction Industrial Waste Loadings (1948-1963)			71%	72%	22%	79%	51%
1962-63 PHS	Domestic	541	1,270	3	34,300	16,000	626,000

* Included steam generating plants

FIGURE 15-Z



LEGEND

——— 1962–1963 Detroit Project Data (MF)
– – – 1946–1948 IJC Data (MPN)

SCALE

Horizontal—Distance from West Shore as Indicated
Vertical—Log Scale Total Coliform per 100ml as Indicated

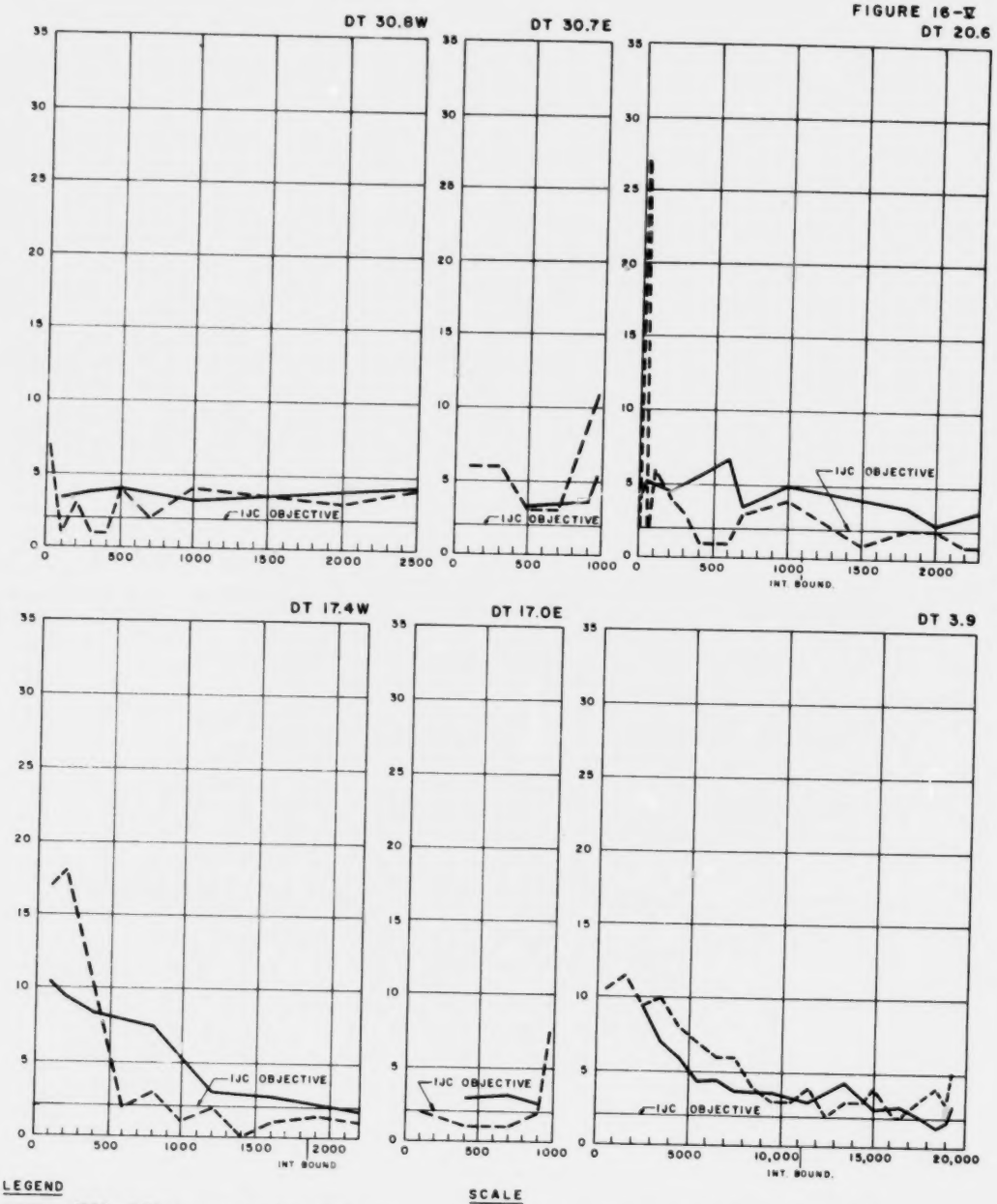
DETROIT RIVER–LAKE ERIE PROJECT

MEDIAN COLIFORM CONCENTRATIONS

DETROIT RIVER

U.S. DEPARTMENT OF HEALTH, EDUCATION, & WELFARE
PUBLIC HEALTH SERVICE
REGION V GROSSE ILE, MICHIGAN

FIGURE 16-V



LEGEND

1962-1963 Detroit Project Data (MF)

1946-1948 IJC Data (MPN)

SCALE

Horizontal-Distance from West Shore as Indicated

Vertical- Avg. Phenol-Micrograms per Liter as Indicated

DETROIT RIVER-LAKE ERIE PROJECT

AVERAGE PHENOL CONCENTRATIONS

DETROIT RIVER

U.S. DEPARTMENT OF HEALTH, EDUCATION, & WELFARE
PUBLIC HEALTH SERVICE
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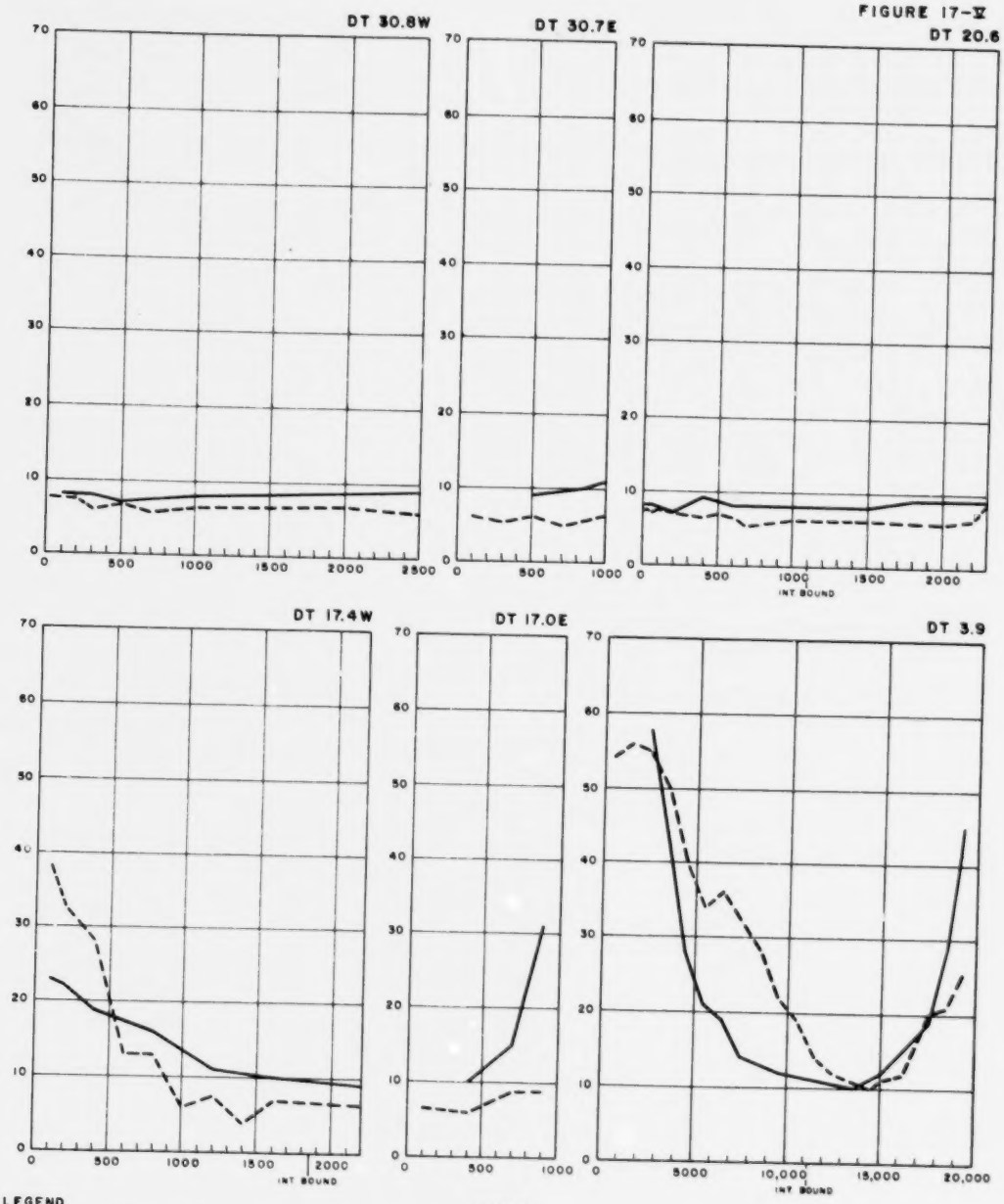
FIGURE 17-V



LEGEND

1962-1963 Detroit Project Data (MF)

1946-1948 IJC Data (MPN)

SCALE

Horizontal-Distance from West Shore as Indicated

Vertical- Avg. Chloride-Milligrams per Liter as Indicated

DETROIT RIVER-LAKE ERIE PROJECT

AVERAGE CHLORIDE CONCENTRATIONS

DETROIT RIVER

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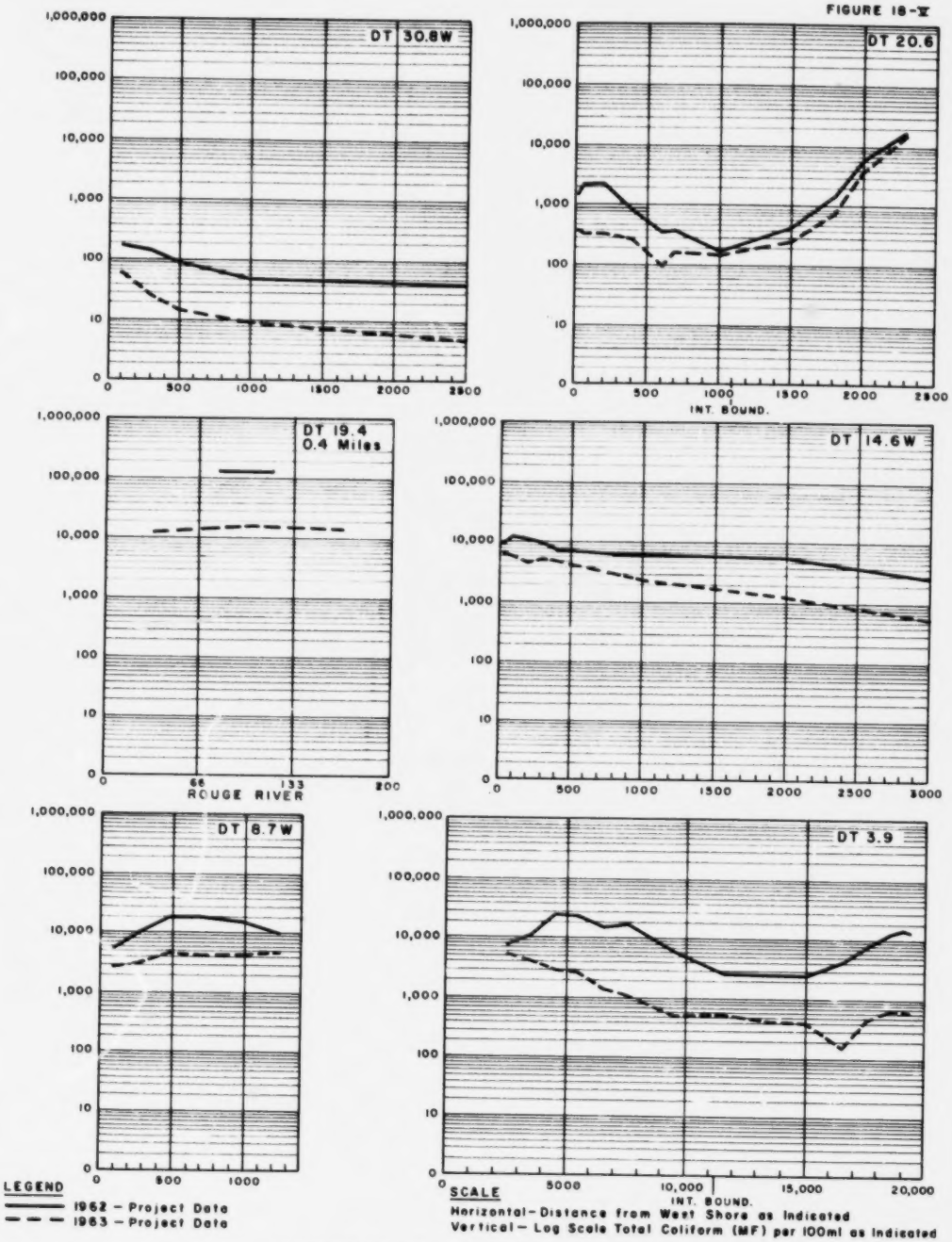
FIGURE 18-V



DETROIT RIVER–LAKE ERIE PROJECT

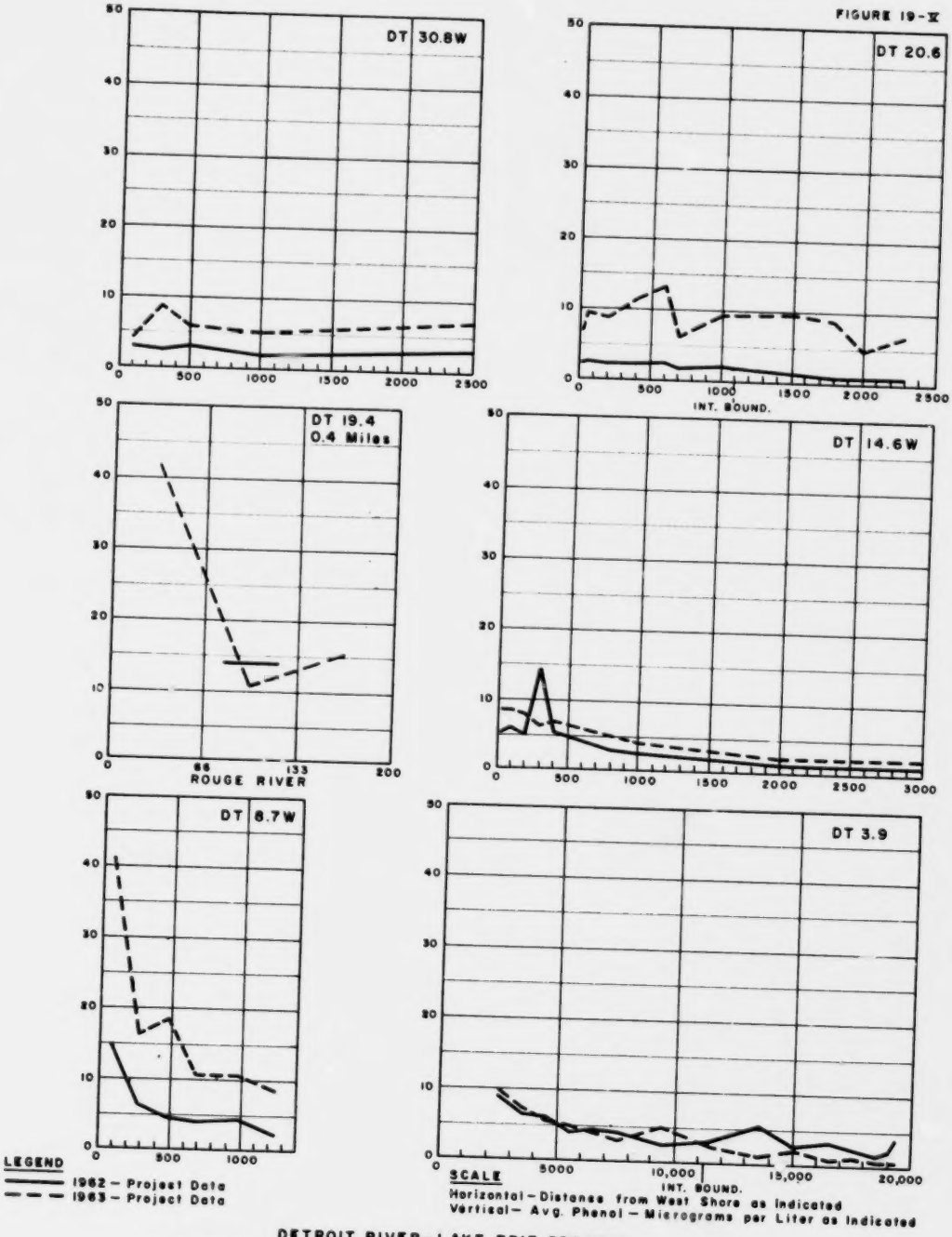
GEOMETRIC MEAN COLIFORM CONCENTRATIONS

1962–1963

DETROIT RIVER

U.S. DEPARTMENT OF HEALTH, EDUCATION, & WELFARE
PUBLIC HEALTH SERVICE
REGION V GROSSE ILE, MICHIGAN

FIGURE 19-X



DETROIT RIVER–LAKE ERIE PROJECT

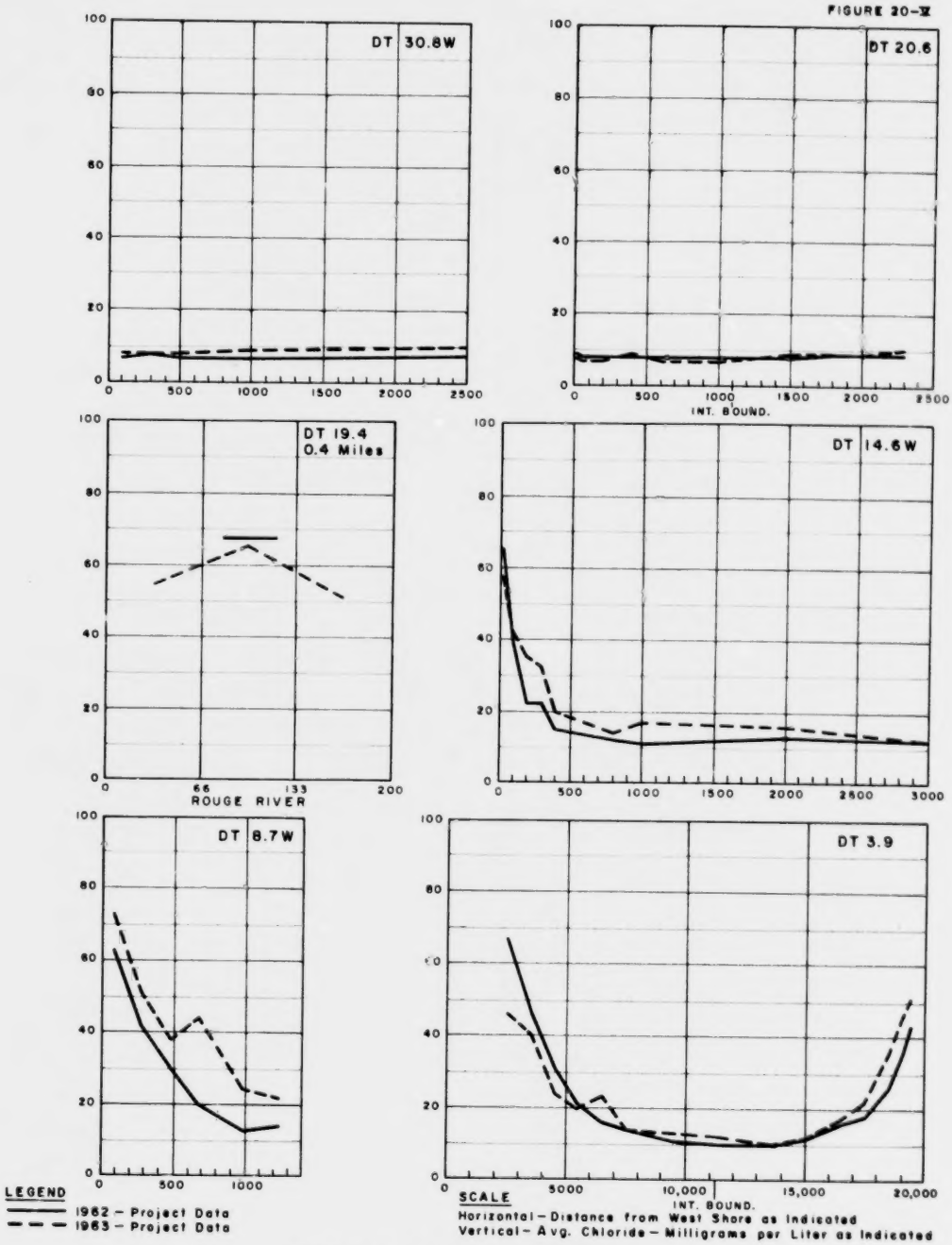
AVERAGE PHENOL CONCENTRATIONS

1962–1963

DETROIT RIVER

U.S. DEPARTMENT OF HEALTH, EDUCATION, & WELFARE
PUBLIC HEALTH SERVICE
REGION V GROSSE ILE, MICHIGAN

FIGURE 20-Z



DETROIT RIVER–LAKE ERIE PROJECT

AVERAGE CHLORIDE CONCENTRATIONS

1962–1963

DETROIT RIVER

U.S. DEPARTMENT OF HEALTH, EDUCATION, & WELFARE
PUBLIC HEALTH SERVICE
REGION V GROSSE ILE, MICHIGAN

SOURCES AND CHARACTERISTICS OF WASTES

Municipal

In addition to study of operating records of sewage treatment plants (see Figures 11-I through 15-I), 4-day surveys were made in cooperation with the Michigan Department of Health during which waste flows were measured and hourly bacteriological samples and 12-hour composite chemical, biochemical, and physical samples were collected and analyzed. Summer and fall surveys were made at the Detroit and Wyandotte Treatment plants and a single survey conducted at the remaining installations.

The location of the sewage treatment plant outfalls in the Detroit River is shown in Figure 7-II. Table 6-V summarizes the results of the surveys while Table 7-V lists the waste loadings in some quantitative unit, such as pounds or gallons. Table 8-V summarizes treatment efficiency in removing certain waste constituents.

Detroit (Belle Isle Sewage Treatment Plant)

Results from the survey revealed a plant influent of low density and treatment removal efficiencies within accepted limits for this type of facility. While BOD removal was low (25%), the low density in the influent (60 mg/l) makes it difficult to achieve a higher degree of removal. Total coliform and fecal streptococcus densities in the effluent were high (7,890,000 and 297,000), but must be expected in a plant not chlorinating its effluent.

Detroit (Main Sewage Treatment Plant)

The plant effluent contained waste constituents at levels normally not associated with domestic wastes. Among these constituents are oil and grease, phenols, copper, iron, chromium, nickel, zinc, and lead. Average phenol effluent concentration during the two surveys was 303 μg/l, far in excess of the 20 μg/l value recommended by the International Joint Commission. Effluent oil concentration averaged 30 mg/l, which is double the International Joint Commission recommended effluent concentrations of 15 mg/l. Oil and phenol waste loadings to the Detroit River during this survey were high (15,500 gallons/day and 1,260 lbs/day respectively).

Ammonia-nitrogen concentration in the effluent was high (7.7 mg/l), as were ammonia loadings (31,500 lbs/day). All forms of nitrogen averaged 12 mg/l, representing a loading to the River of over 51,000 lbs/day. Phosphate effluent concentration averaged 36 mg/l in the total form and 14 mg/l in the soluble form, representing a discharge to the Detroit River of 145,000 and 65,000 lbs/day.

Suspended solids, settleable solids, and BOD values in the plant effluent are high at 140, 60, and 109 mg/l. Treatment efficiency for these substances is low, although long term records show that higher efficiency has been achieved at other times. Settleable solids removal during the survey was poor at 54%. The average suspended solids loading of 607,000 lbs/day is high. BOD loadings to the Detroit River of 500,000 lbs/day represent a population equivalent of approximately 3 million.

Bacteria removal during the survey was excellent and density in the effluent very low with geometric means for total and fecal coliform and fecal streptococcus under 125 organisms per 100 ml during the first survey and all under 500 organisms per 100 ml during the second. While averages during the survey do not correspond with mean monthly averages during the study period (see Figure 11-I), they indicate that effective bacterial control can be accomplished. During the eight days of the survey period 14 percent of the

samples collected exceeded 2400 organisms per 100 ml and 4.5% exceeded 20,000 organisms per 100 ml. During this same period 15% of the fecal streptococcus samples exceeded 2,400 organisms per 100 ml and 1% exceeded 10,000, indicating that fecal streptococci were not as effectively reduced by chlorination as were coliforms.

Wayne County Sewage Treatment Plant (Wyandotte)

Results of the surveys indicate waste constituents at levels normally not associated with domestic sewage. These include phenols, oil and grease, iron, chromium, copper, cadmium, nickel, zinc, and lead.

Average concentrations of suspended solids and settleable solids were high (95 and 32 mg/l) during the two surveys and loadings to the River significant (17,000 and 5,600 lbs/day). Average BOD in the effluent during the first survey was high (120 mg/l) and the loadings significant (22,100 lbs/day). This discharge represents a population equivalent of 132,000. Treatment efficiency in this type of plant for BOD and suspended solids removal was in the expected range of 35% and 61% respectively.

Average phenol concentration in the effluent was 71 μg/l, far above the International Joint Commission recommended effluent level of 20 μg/l, and oil and grease average effluent values of 20 mg/l slightly above the International Joint Commission recommended limit of 15 mg/l.

Average ammonia nitrogen effluent concentration during the two surveys was high (16 mg/l) and loading to the River also great (2,900 lbs/day). Total nitrogen compounds, as nitrogen, averaged 19 mg/l in the effluent, representing loadings of over 3,400 lbs/day. Phosphates were in the effluent in average concentrations of 40 mg/l in the total form and 28 mg/l in the soluble form. This represents waste discharges of phosphates to the River of over 7,200 and 5,000 lbs/day respectively.

Bacteriological control was excellent during the first survey when chlorination of the effluent was practiced. Geometric mean densities for total coliforms, fecal coliforms and fecal streptococci during the first survey was less than 100 organisms per 100 ml. Study of plant operation records (Figure II-I) reveals these results are not typical, but it is encouraging to note that results of this magnitude can be obtained. During the survey 3% of the total coliform results exceed 2,400 organisms per 100 ml and none exceed 10,000 organisms per 100 ml. During the second survey effluent chlorination was not practiced and geometric means for total coliforms, fecal coliforms and fecal streptococci exceeded one million.

The cyanide concentration from the Wyandotte plant reached maximum values during the first survey of 0.11 mg/l, and the average loading to the River was 3 lbs/day.

Wayne County Sewage Treatment Plant (Trenton)

Results of the Trenton survey revealed high concentrations of oil and grease, and phenols in the plant effluent (41 mg/l and 24 μg/l). Values of both constituents exceeded International Joint Commission recommended effluent levels of (15 mg/l and 20 μg/l, respectively.

Average suspended and settleable solids in the effluent were high, at 80 and 14 mg/l, but treatment efficiency was within the range expected for this type of installation. Average suspended solids discharged to the Detroit River were 1,600 pounds per day. BOD in the effluent averaged 83 mg/l, representing a loading of 1,780 pounds per day or a population equivalent of over 10,000. Treatment efficiency in BOD removal was 33 percent.

Plant	Survey No.	Dates of Survey	Avg. Flow MGD	Type of Sample	Avg. Susp. Solids mg/l	Avg. Sett. Solids mg/l	Avg. BOD mg/l	Avg. COD mg/l	Avg. Phenols µg/l	Avg. Oil & Grease mg/l	Avg. NH_3 N mg/l	Avg. Org. N mg/l	Avg. NO_3 N mg/l	Avg. NO_2 N mg/l	Avg. Sol. PO_4 mg/l
DETROIT	1	June 16 through June 19, 1963	548	Influent	220	139	132	350	809	34	2.4	2.2	-	.001	17
				Effluent	106	35	109	254	410	23	2.6	2.1	-	-	14
DETROIT	2	Nov. 4 through Nov. 7, 1963	485	Influent	233	120	-	-	307	62	12.7	9.4	.051	.004	-
				Effluent	175	85	-	-	197	37	12.9	6.2	.194	-	-
DETROIT	Avg. of 1 & 2	-	516	Influent	226	129	132	350	558	48	7.5	5.8	.051	.002	17
				Effluent	140	60	109	254	303	30	7.7	4.2	.194	-	14
WAYNE CO. (WYANDOTTE)	1	Aug. 11 through Aug. 14, 1963	22.5	Influent	149	91	186	415	36	20	20	0.9	-	-	27
				Effluent	67	11	120	291	34	13	15	1.0	-	-	28
WAYNE CO. (WYANDOTTE)	2	Nov. 4 through Nov. 7, 1963	21.5	Influent	367	303	-	-	116	68	20	5.9	.040	.029	-
				Effluent	122	54	-	-	108	26	17	5.3	.058	.006	-
WAYNE CO. (WYANDOTTE)	Avg. of 1 & 2	-	21.1	Influent	258	197	186	415	76	44	20	3.4	.040	.029	27
				Effluent	94	32	120	291	71	20	16	3.1	.058	.006	28
WAYNE CO. (TRENTON)	-	June 23 through June 26 1963	2.42	Influent	158	105	124	445	31	29	5.6	1.0	-	.052	31
				Effluent	80	14	83	269	24	41	4.1	1.8	-	-	34
WAYNE CO. (GROSSE ILE)	-	June 9 through June 12, 1963	0.15	Influent	151	65	122	358	22	19	3.7	6.3	-	.019	23.9
				Effluent	63	9	80	319	26	22	2.5	1.8	-	-	29.2
DETROIT (BELLE ISLE)	-	Aug. 11 through Aug. 14, 1963	0.31	Influent	41	19	60	133	-	15	-	-	-	-	-
				Effluent	19	5	45	72	-	12	-	-	-	-	-

LIST OF ABBREVIATIONS

MGD - million gallons per day
mg/l - milligrams per liter
Susp. - Suspended
Sett. - Settleable
BOD - Biochemical Oxygen Demand
COD - Chemical Oxygen Demand
µg/l - micrograms per liter
NH_3 N - Ammonia Nitrogen
Org. N - Organic Nitrogen
NO_3 N - Nitrate Nitrogen
NO_2 N - Nitrite Nitrogen
Sol. PO_4 - Soluble Phosphates
Tot. PO_4 - Total Phosphates
Cl - Chlorides
ABS - Alkyl Benzene Sulfonate

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...ds	Avg. BOD	Avg. COD	Avg. Phenols	Avg. Oil & Grease	Avg. NH_3 N	Avg. Org. N	Avg. NO_3 N	Avg. NO_2 N	Avg. Sol. PO_4	Avg. Tot. PO_4	Avg. Cl	pH Range	Avg. ABS	Avg. Iron	Avg. Cu	Avg. Cd	Avg. Ni	Avg. Zn	Avg. Pb	Avg. CN	Avg. Cl_2 Resid.	Total
...l	mg/1	mg/1	µg/1	mg/1	mg/1	mg/1	mg/1	mg/1	mg/1	mg/1	mg/1	units	mg/1	mg/1	mg/1	mg/1	mg/1	mg/1	mg/1	mg/1	mg/1	maximum
...9	132	350	800	34	2.4	2.2	-	.001	17	-	184	7.0-7.5	3.82	8.03	0.36	0.015	0.52	0.44	0.16	-	-	85,000,000
...5	109	254	410	23	2.6	2.1	-	-	14	-	124	7.0-7.6	4.55	5.51	0.19	-	0.35	-	0.11	L.01	1.78	71,000
...0	-	-	307	62	12.7	9.4	.051	.001	-	36	-	6.8-7.0	-	-	-	-	-	-	-	-	-	67,000,000
...5	-	-	197	37	12.9	6.2	.194	-	-	36	-	6.8-7.0	-	-	-	-	-	-	-	-	-	74,000
...9	132	350	558	48	7.5	5.8	.051	.002	17	36	184	6.8-7.5	3.82	8.03	0.36	0.015	0.52	0.44	0.16	-	-	76,000,000
...0	109	254	303	30	7.7	4.2	.194	-	14	36	124	6.8-7.6	4.55	5.51	0.19	-	0.35	-	0.11	L.01	1.78	72,500
...	186	415	36	20	20	0.9	-	-	27	-	184	7.3-7.6	5.85	1.92	0.05	0.02	0.02	0.36	0.08	-	-	100,000,000
...	120	291	34	13	15	1.0	-	-	28	-	189	7.1-7.6	6.17	1.08	0.07	0.03	0.03	0.31	0.05	0.03	0.7	10,000
...	-	-	116	68	20	5.9	.040	.029	-	47	-	6.9-7.2	-	-	-	-	-	-	-	-	-	230,000,000
...	-	-	108	26	17	5.3	.058	.006	-	40	-	6.8-7.2	-	-	-	-	-	-	-	-	-	210,000,000
...	186	415	76	44	20	3.4	.040	.029	27	47	184	6.9-7.6	5.85	1.92	0.05	0.02	0.02	0.36	0.08	-	-	165,000,000
...	120	291	71	20	16	3.1	.058	.006	28	40	189	6.8-7.6	6.17	1.08	0.07	0.03	0.03	0.31	0.05	0.03	0.7	-
...	124	445	31	29	5.6	1.0	-	.052	31	-	87	6.8-7.4	7.32	2.24	0.18	0.22	0.09	0.99	0.09	32	-	73,000,000
...	83	269	24	41	4.1	1.8	-	-	34	-	87	6.9-7.5	6.76	1.77	0.14	0.22	0.09	0.35	0.07	0.18	1.0+	11,900
...	122	358	22	19	3.7	6.3	-	.019	23.9	-	70	6.8-7.4	4.96	1.81	0.05	-	0.01	0.11	0.04	0	-	10,900,000
...	80	319	26	22	2.5	1.8	-	-	29.2	-	63	6.8-7.6	5.36	1.24	-	-	0.01	0.08	-	0	2.0	56,000
...	60	133	-	15	-	-	-	-	-	-	43	7.3-7.5	-	-	-	-	-	-	-	-	-	94,000,000
...	45	72	-	12	-	-	-	-	-	-	43	7.3-7.5	-	-	-	-	-	-	-	-	-	48,000,000

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NO_2 N - Nitrite Nitrogen
Sol. PO_4 - Soluble Phosphates
Tot. PO_4 - Total Phosphates
Cl - Chlorides
ABS - Alkyl Benzene Sulfonate

Cu - Copper
Cd - Cadmium
Ni - Nickel
Zn - Zinc
Pb - Lead

CN - Cyanide
Cl_2 Resid. - Chlorine Residual
Geom. - Geometric
P.E. - Population Equivalent

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TABLE 6-V. SUMMARY OF RESULTS OF DOMESTIC WASTE SURVEYS

DETROIT RIVER

	Avg. CN	Avg. Cl_2 Resid.	Total Coliform Organisms per 100 ml			Fecal Coliform Organisms per 100 ml			Fecal Streptococci Organisms per 100 ml		
	mg/l	mg/l	maximum	minimum	geom. mean	maximum	minimum	geom. mean	maximum	minimum	geom. mean
16	-	-	85,000,000	14,000,000	36,200,000	42,000,000	5,600,000	16,100,000	580,000	175,000	391,000
11	L.01	1.78	71,000	L 10	79	-	L 10	-	6,840	L 10	122
-	-	-	67,000,000	5,600,000	27,000,000	48,500,000	2,000,000	10,500,000	2,200,000	600,000	1,170,000
-	-	-	74,000	L 10	411	68,000	L 10	-	12,000	L 10	175
16	-	-	76,000,000	9,800,000	31,600,000	45,200,000	3,800,000	13,300,000	1,390,000	387,000	780,000
11	L.01	1.78	72,500	L 10	245	68,000	L 10	-	9,420	L 10	148
68	-	-	100,000,000	32,000,000	67,500,000	100,000,000	42,000,000	65,000,000	16,000,000	4,300	690,000
05	0.03	0.7	10,000	L 10	31	-	L 10	-	140	10	45
-	-	-	230,000,000	46,000,000	101,000,000	152,000,000	6,900,000	43,800,000	2,000,000	660,000	1,030,000
-	-	-	210,000,000	15,000,000	41,000,000	65,500,000	7,500,000	23,100,000	22,000,000	490,000	1,310,000
68	-	-	165,000,000	39,000,000	84,200,000	126,000,000	24,400,000	54,400,000	9,000,000	331,000	860,000
5	0.03	0.7	-	-	-	-	-	-	-	-	-
9	32	-	73,000,000	20,000,000	34,100,000	24,500,000	6,600,000	12,500,000	1,660,000	420,000	645,000
7	0.18	1.0+	11,900	L 10	14	-	L 10	-	30	L 10	12
4	0	-	10,900,000	3,600,000	5,840,000	7,600,000	1,200,000	3,400,000	500,000	240,000	300,000
-	0	2.0	56,000	L 10	21	-	L 10	-	L 10	L 10	L 10
-	-	-	94,000,000	L 1,000,000	11,600,000	84,700,000	4,400,000	14,600,000	24,000,000	37,200	1,030,000
-	-	-	48,000,000	L 10,000	7,890,000	42,000,000	L 5,000	4,800,000	1,800,000	2,800	297,000

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	Survey No.	Dates of Survey	Susp. Solids	Sett. Solids	BOD	BOD P.E.	Ph
			lbs/day	lbs/day	lbs/day	people	lb
DETROIT	1	June 16-19	488,000	188,000	501,000	2,940,000	
DETROIT	2	Nov. 4-7	727,000	381,000	-	-	
DETROIT	Avg.	-	607,000	284,000	501,000	2,940,000	
WAYNE CO. (WYANDOTTE)	1	Aug. 11-14	12,400	1,510	22,100	130,000	
WAYNE CO. (WYANDOTTE)	2	Nov. 4-7	22,300	9,960	-	-	
WAYNE CO. (WYANDOTTE)	Avg.	-	17,400	5,735	22,100	130,000	
WAYNE CO. (TRENTON)	-	June 23-26	1,610	301	1,780	10,500	
WAYNE CO. (GROSSE ILE)	-	June 9-12	56	4	100	590	
DETROIT (BELLE ISLE)	-	Aug. 11-14	37	L 1	97	570	
Total Loadings to Detroit River*	-		626,000	290,000	525,000	3,080,000	1

	Survey No.	Dates of Survey	Total Coliforms	Total Fecal Coliforms	To Fe Strep
			number/day	number/day	nu
DETROIT	1	June 16-19	16.4×10^{11}	-	25.3
DETROIT	2	Nov. 4-7	75.5×10^{11}	36.2×10^{11}	32.1
DETROIT	Avg.	-	45.9×10^{11}	36.2×10^{11}	28.7
WAYNE CO. (WYANDOTTE)	1	Aug. 11-14	26.5×10^{9}	-	38.4
WAYNE CO. (WYANDOTTE)	2	Nov. 4-7	33.3×10^{15}	14.6×10^{15}	10.6
WAYNE CO. (WYANDOTTE)	Avg.	-	-	-	
WAYNE CO. (TRENTON)	-	June 23-26	12.8×10^{8}	-	11.0
WAYNE CO. (GROSSE ILE)	-	June 9-12	12.2×10^{7}	-	58
DETROIT (BELLE ISLE)	-	Aug. 11-14	90.7×10^{12}	79.8×10^{12}	34.1
Total Loadings to Detroit River*	-		92.4×10^{12} ## 33.4×10^{15} ###	14.7×10^{15} ###	59.8

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TABLE 7

	BOD P.E.	Phenols	Oil & Grease	NH_3 N	Org. N	NO_3 N	NO_2 N	Sol. PO_4	Tot. PO_4	Chloride	ABS	
y	people	lbs/day	gallons	lbs/day	lbs/day	lbs/day	lbs/day	lbs/day	lbs/day	lbs/day	lbs/day	
000	2,940,000	1,760	12,700	10,300	10,000	-	-	65,000	-	562,000	20,800	
-	-	765	18,300	52,200	23,100	669	-	-	145,000	-	-	
0	2,940,000	1,260	15,500	31,500	16,600	669	-	65,000	145,000	562,000	20,800	
0	130,000	6.3	206	2,310	199	-	-	5,150	-	35,000	1,160	
-	-	10.2	555	3,000	939	24	1.1	-	7,290	-	-	
0	130,000	12.7	425	2,700	569	24	1.1	5,150	7,290	35,000	1,160	
0	10,500	0.49	76	[illegible]	36	-	-	715	-	1,640	146	
0	500	0.03	[illegible]	3.1	2.2	-	-	35	-	78	6.7	
7	570	-	[illegible]	-	-	-	-	-	-	101	-	
0	3,050,000	1,270	16,000	34,300	[illegible]	691	-	70,000	152,000	[illegible]	22,100	

al al forms	Total Fecal Streptococci
ber/day	number/day
-	25.3×10^{11}
$\times 10^{11}$	32.1×10^{11}
$\times 10^{11}$	28.7×10^{11}
-	81.4×10^{12}
$\times 10^{15}$	10.6×10^{14}
-	-
-	11.0×10^{8}
-	98×10^{6}
$\times 10^{12}$	34.1×10^{11}
10^{15} ℓℓ	50.8×10^{11} ℓ

* - Rounded to three significant figures

ℓ - summer survey

ℓℓ - fall survey

TABLE 7-V. SUMMARY OF WASTE LOADINGS - DOMESTIC WASTE SURVEYS

DETROIT RIVER

O_2 N	Sol. PO_4	Tot. PO_4	Chloride	ABS	Iron	Copper	Cadmium	Nickel	Zinc	Lead	Cyanide
/day	lbs/day	lbs/day	lbs/day	lbs/day	lbs/day	lbs/day	lbs/day	lbs/day	lbs/day	lbs/day	lbs/day
-	65,000	-	562,000	20,800	25,200	870	-	1,600	-	502	L 45
-	-	145,000	-	-	-	-	-	-	-	-	-
-	65,000	145,000	562,000	20,800	25,200	870	-	1,600	-	502	L 45
-	5,150	-	35,000	1,160	202	13.1	5.6	5.6	58.1	9.4	5.6
1.1	-	7,290	-	-	-	-	-	-	-	-	-
1.1	5,150	7,290	35,000	1,160	202	13.1	5.6	5.6	58.1	9.4	5.6
-	715	-	1,640	146	38	3.0	4.7	1.9	7.6	1.5	3.9
-	35	-	78	6.7	1.5	-	-	0.01	0.1	-	0
-	-	-	101	-	-	-	-	-	-	-	-
-	70,900	152,000	599,000	22,100	25,400	886	-	1,610	-	512	L 55

gnificant figures

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	Survey No.	Date of Survey	Susp. Solids	Sett. Solids	BOD	COD
			% removal	% removal	% removal	% remov
DETROIT	1	June 16-19	53	75	17	27
DETROIT	2	Nov. 4-7	25	29	-	-
DETROIT	Avg.	-	39	52	17	27
WAYNE CO. (WYANDOTTE)	1	Aug. 11-14	55	88	35	30
WAYNE CO. (WYANDOTTE)	2	Nov. 4-7	67	82	-	-
WAYNE CO. (WYANDOTTE)	Avg.	-	61	85	35	30
WAYNE CO. (TRENTON)	-	June 23-26	49	87	33	40
WAYNE CO. (GROSSE ILE)	-	June 9-12	59	86	34	11
DETROIT (BELLE ISLE)	-	Aug. 11-14	54	74	25	46

	Survey No.	Date of Survey	Nickel	Zinc	Lead	Cyanide
			% removal	% removal	% removal	% remove
DETROIT	1	June 16-19	33	-	31	-
DETROIT	2	Nov. 4-7	-	-	-	-
DETROIT	Avg.	-	33	-	31	-
WAYNE CO. (WYANDOTTE)	1	Aug. 11-14	0	14	37	-
WAYNE CO. (WYANDOTTE)	2	Nov. 4-7	-	-	-	-
WAYNE CO. (WYANDOTTE)	Avg.	-	0	14	37	-
WAYNE CO. (TRENTON)	-	June 23-26	0	65	22	99.4
WAYNE CO. (GROSSE ILE)	-	June 9-12	0	27	-	-
DETROIT (BELLE ISLE)	-	Aug. 11-14	-	-	-	-

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TABLE 8-V. S

BOD	COD	Phenols	Oil & Grease	Ammonia Nitrogen	Organic Nitrogen	Nitrate Nitrogen	Nitrite Nitrogen	Soluble Phosphates	Total Phosphates	Ch
removal	% removal	% removal	% removal	% removal	% removal	% removal	% removal	% removal	% removal	%
17	27	49	32	0	5	-	-	18	-	
-	-	36	40	0	34	0	-	-	0	
17	27	42	36	0	20	0	-	18	0	
35	30	6	35	25	0	-	-	0	-	
-	-	7	62	15	10	0	79	-	15	
35	30	7	48	20	5	0	79	0	15	
33	40	23	0	27	0	-	-	0	-	
34	11	0	0	33	72	-	-	0	-	
25	46	-	20		-	-	-	-	-	

ead	Cyanide	Total Coliforms	Fecal Coliforms	Fecal Streptococci
moval	% removal	% removal	% removal	% removal
1	-	99.99	99.99	99.99
-	-	99.99	99.99	99.99
1	-	99.99	99.99	99.99
7	-	99.99	99.99	99.99
-	-	60	47	0
7	-	-	-	-
2	99.4	99.99	99.99	99.99
-	-	99.99	99.99	99.99
-	-	32	67	71

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TABLE 8-V. SUMMARY OF TREATMENT EFFICIENCY - DOMESTIC WASTE SURVEYS
DETROIT RIVER

ic gen oval	Nitrate Nitrogen % removal	Nitrite Nitrogen % removal	Soluble Phosphates % removal	Total Phosphates % removal	Chlorides % removal	ABS % removal	Iron % removal	Copper % removal	Cadmium % removal	ecal ptococci removal
	-	-	18	-	33	0	31	47	-	99.99
	0	-	-	0	-	-	-	-	-	99.99
	0	-	18	0	33	0	31	47	-	99.99
	-	-	0	-	0	0	44	0	0	99.99
	0	79	-	15	-	-	-	-	-	0
	0	79	0	15	0	0	44	0	0	-
	-	-	0	-	0	7	21	22	0	9.99
	-	-	0	-	10	0	31	0	0	9.99
	-	-	-	-	0	-	-	-	-	71

Bacteriological control during the survey was excellent, with all samples examined averaging less than 15 organisms per 100 ml. Examination of plant records (Figure 11-I) reveals that these values were not typical, however.

Wayne County Sewage Treatment Plant (Grosse Ile)

This survey revealed phenols and oil and grease effluent concentrations in excess of International Joint Commission recommended effluent limits.

Suspended and settleable solids in the effluent averaged 63 and 9 mg/l respectively, and the removal efficiency for suspended solids, 59%, was within expected limits for this type of installation. BOD averaged 80 mg/l in the effluent, which represents a population equivalent of 650.

Bacterial control during the survey was excellent, with effluent geometric means for all organisms examined under 25 per 100 ml.

The table below lists present loadings of iron, oil, phenols, and suspended solids, and the reductions which would be effected if IJC recommended effluent limitations and a suspended solids limitation of 35 mg/l were met at all the domestic sewage treatment plants in the Detroit area.

Pollutant	Present Loading	Loading After Reduction	Per Cent Reduction
Oil and Grease	16,000 gallons/day	8,420 gallons/day	47
Phenols	1,270 pounds/day	90 pounds/day	93
Iron	25,400 pounds/day	25,400 pounds/day	0
Suspended Solids	626,000 pounds/day	159,000 pounds/day	74.6

Approximately 99 per cent of the iron from domestic sources being discharged to the Detroit River originates from the Detroit Sewage Treatment Plant. The average iron concentration of 5.5 mg/l meets IJC recommended effluent limitations, but is still a substantial loading to the River.

The main treatment plant of the City of Detroit is the major domestic source of almost all waste constituents. For example, Detroit discharges 99 per cent of the iron from domestic sources, 99 per cent of the phenols, 97 per cent of the oil, 95 per cent of the BOD, 97 per cent of the suspended solids, 98 per cent of the settleable solids, and 99 per cent of the toxic metals. It also constitutes 95 per cent of the total volume of wastes discharged and serves 91 per cent of the people served by sewage treatment plants discharging wastes to the Detroit River.

Industrial

Industry in the Detroit area differs from that in many other metropolitan areas in that manufacturing is primarily centered around a single industry--motor vehicle production--and the production of raw materials, parts, and accessories that go into the manufacture of transportation equipment. Production of synthetic organics and heavy chemicals from the extensive underground salt deposits of the region is another large segment of the industry of the area. One paper plant on the Rouge River manufactures paper tissues by the sulfite process. There are also pharmaceutical, rendering, petroleum refining and metal-finishing industries in the Detroit area. Figures 5-II and 6-II show the location of all the industries investigated in the study.

Investigation of these sources of industrial wastes was accomplished jointly by the Michigan Water Resources Commission and the U.S. Public Health Service. Individual surveys were made of each industry discharging wastes directly to the Detroit River and certain of its tributaries. In addition, outfall grab samples were collected throughout the duration of the Project. Results from both were considered in formulating conclusions and recommendations for improvement of waste treatment.

Tables 9-V and 10-V summarize survey results for 35 industries on the Detroit River. Table 9-V contains average concentrations of selected waste constituents while Table 10-V summarizes waste loadings in some quantitative unit, such as pounds or gallons per day. In the computation of waste loadings contributed by each industry, only the increase over values found in the plants' raw water supply was used. In most cases, values found during the intensive surveys were used as reported, while some were modified by additional grab samples collected from plant effluents.

Tables 11-V through 13-V list the industries by name and location which discharge wastes directly to the study waters of the Detroit River and Rouge River. The tables include information on production (where available), waste water volume, significant waste constituents, and treatment and control employed for the process wastes. The tables do not include data on sewage from plant employees, as in all but a few minor cases the sewage is discharged to municipal sewers and is considered in the discussion of domestic wastes. Industries which discharge process wastes to municipal sewerage systems are also not included, since satisfactory disposal of these wastes is the responsibility of the municipality involved and is considered in the section on domestic wastes. The total quantity of waste water released by the Detroit and Rouge River industries is 1.1 billion gallons per day. Undoubtedly, significant additional waste discharges are caused by accidental spills of industrial wastes not reflected in effluent measurements.

Rouge River Industries

Nine plants on the Rouge River use this watercourse as the receiving stream for their wastes. Their principal products are steel, fabricated metals, heavy chemicals, pulp and paper, cement, and meat-rendering products. (See Table 11-V.) These plants produce a total waste volume of 484 million gallons per day. 83% of this volume originates from the Ford Motor Company. Principal waste are iron, oxygen-demanding materials, bacteria, suspended solids, oil, pickling liquor, phenols, chlorides, cyanides, toxic metals, and ammonia. With the exception of the American Agricultural Chemical Company and Peerless Cement, the industries provide some form of treatment to restrict discharge of wastes to the Rouge River.

Upper Detroit River Industries

Six industries (shown in Table 12-V) discharge wastes directly to the Detroit River above the Rouge River outlet. The Allied Chemical Corporation, Solvay Process Division, discharges a portion of its wastes through the Schroeder Avenue storm sewer and

one outfall located on Zug Island immediately below the outfalls of the Great Lakes Steel Corporation, Blast Furnace Division. These six plants manufacture copper and brass products, pharmaceuticals, rubber tires, soda ash, coke, and iron. Significant waste constituents originating from these industries consist of chlorides, iron, suspended solids, phenols, ammonia, and oil. All, with the exception of Parke Davis, provide some form of treatment.

Lower Detroit River Industries

Twenty-one industries (shown in Table 13-V) release wastes directly to the Detroit River below the Rouge River. Four are large steel manufacturing complexes, four produce automobile machinery, nine manufacture synthetic organic and heavy chemicals, others make industrial adhesives and petroleum products, and one is engaged in the vessel-washing business. Waste constituents include acids, oxidizing agents, suspended solids, phosphates, oil, ammonia, phenols, oxygen-demanding materials, iron, and chlorides. Common waste treatment methods are oil separation, oxidation for phenol control, and ponding for sedimentation and controlled waste discharge. Industries that do not provide any means of treatment are Chrysler Corporation (Amplex and Chemical Products Divisions), Dana Corporation, duPont, Koppers Company, and the Pennsalt Chemical Corporation East Plant.

In the Detroit area the principal waste constituents discharged directly to adjacent waters are suspended solids, BOD, oil, phenols, acid, ammonia, chlorides, iron, and toxic ions in plating and metal finishing wastes such as cyanide, chromium, copper, cadmium, nickel, zinc, and lead.

Size of Waste Loadings

Table 14-V summarizes waste loading by area of contribution for several waste constituents. Waste loadings represent amounts added by each industry in excess of those in the raw water supply used by the industry.

Table 15-V shows those concentrations of waste materials released to the Rouge River which either exceed the IJC recommendations for control of boundary water quality or exceed reasonable limits for effective waste control. In the case of suspended solids, the judgment was based on the fact that effective sedimentation of wastes should remove essentially all of the readily settleable material and reduce the remaining suspended solids to a level not to exceed 35 mg/l.

The principal wastes from the Allied Chemical Corporation plants are chlorides, phenols, and suspended solids from the two Solvay Process plants which typify wastes produced in making soda ash. These plants produce their own coke for firing the ovens, which accounts for the phenolic compounds. The Plastic Division plant produces phenolic waste from the distillation of crude tar in making carbolic oils and pitch. Darling and Company, a meat-rendering plant, produces wastes similar to those from a slaughterhouse with ineffective control measures. The effluent is high in organic content - 7,000 pounds per day BOD.

The Ford Motor Company Rouge Plant is one of the largest of its kind in the world and has in the past been able to manufacture an automobile from the basic raw materials of iron ore, sand, and crude rubber. Their waste products exhibit the vastness of the operation. Ford Motor Company, by far the largest water user in the Rouge River,

releases large quantities of wastes, as seen in Table 10-V. The following listing gives the percent of industrial waste constituents discharged to the Rouge River which originates from the Ford Motor Company:

Industrial Waste Constituent	% from Ford
Iron	100
Cyanides	100
Ammonia	95
Toxic Metals	98
Suspended Solids	58
Oil	97.5
Phenols	92.5
Acid	100

It is easily seen that the wastes from the Ford Motor Company contribute significantly to the polluted condition of the Rouge River. The iron, at times as high as 60,000 pounds per day, accounts for the reddish hue of the River, which continues even after dilution with the Detroit River; and excessive quantities of untreated pickle liquor waste, 50,000 pounds per day acid, discolor and corrode the hulls of boats moored in the waters. Iron sludge that settles to the bottom impairs the aquatic life of the area by smothering habitats for reproduction, and in order to maintain the ship channels, the Corps of Engineers must remove large quantities of iron deposits annually in their maintenance dredging program. Ford's phenol discharge of 750 pounds per day exceeds the limits set by the Michigan Water Resources Commission by 150 pounds per day. Cyanides and toxic metals in amounts of 900 and 2,000 pounds are released to the Rouge River daily. Roulo Creek and the Tailrace outlets discharge 95% of the toxic ions. Copper, at 1,500 pounds per day, is the principal toxic metal in the effluent. Ford Motor Company discharges 900 gallons of oil per day which can often be observed as a thin film on the water surface of the Rouge River. Evidence indicates that the oil skimmer stretched across Roulo Creek is not functioning properly as an oil removal device. Probably the oil released to Roulo Creek is largely in the soluble form and does not rise to the surface. High concentrations of iron and oil were found in the sludge deposits of the Ford Motor Company slip. The oil, as well as other pollutants, seriously interferes with the use of the Rouge River for anything but waste disposal.

Scott Paper Company also releases large quantities of waste products, which include oxygen-demanding materials in the amount of 135,000 pounds per day BOD (equivalent to a population of over 800,000). These wastes impose a large burden on the oxygen resources of the Rouge River. Paper pulp passing the traps also contributes to a share of the sediment problem in the Rouge River.

Table 16-V summarizes effluent waste concentrations in the upper Detroit River considered high. Average concentrations and loadings for this area are found in Tables 9-V or 10-V.

The Great Lakes Steel Corporation, Blast Furnace Division, releases a large percentage of the waste materials that enter the upper Detroit River, as shown by the following listing:

Industrial Waste Constituent	% from Great Lakes Steel
Iron	99
Oil	50
Phenols	99
Suspended Solids	45
Toxic Metals	51
Ammonia	100

Industry	Flow MGD	BOD mg/l	COD mg/l	Susp. Sol. mg/l	Sett. Sol. mg/l	Chlorides mg/l	Oil mg/l	Phenols μg/l	
ROUGE RIVER									
Allied Chemical Corp									
General	9.11	-	33-146	22-79	30	46-95	2	5-62	
Plastics	0.48	1.4-950	32-1390	8-62	61	8-55	4	900-10600	.1
Semet Solvay Div.	5.9	2-4	21-31	28-33	-	11-16	-	8-152	
Solvay Process Div.	15.2	6	28-11718	56-257	0-80	34-130000	6-29	7-1090	
Am. Agri. Chem. Co.		1-3	5-22	8-60	-	24-66	-	4-64	
Darling & Company	1.13	830	-	72-147	80	14-15	20-40	31-34	.9
Ford Motor Co.	400	3-6	62	0-171	0-133	9-75	2-30	0-375	.
American Cement Corp. Peerless Cem. Div.	8.1	1-7	34-77	14-549	1-421	9-55	4-7	2-100	.5
Scott Paper Co.	43.8	1080-1350	235-530	74-132	-	93-111	-	63-83	
UPPER DETROIT RIVER									
Allied Chemical Corp Solvay Process Div.	6.4	-	11-12070	20-1600013	-14000	14-160000	10-12	6-460	
Anaconda-American Brass Co.	5.3	4-58	261	26	-	3-7	5-6	5-6	
Great Lakes Steel Blast Furnace Div.	90	3-14	0-27	9-240	8-220	11-326	6-41	3-2500	1.
Parke Davis Company	8.1	1-10	-	4-34	0-27	8-21	2-57	0-380	.3
Revere Copper and Brass Co.	2.9	6-31	-	10-132	7-132	1-12	14-209	0-9	.1
U.S. Rubber Co.	42	3-9	-	0-32	0-22	8-36	5-15	0-14	.6
LOWER DETROIT RIVER									
Chrysler									
Amplex Div.	0.32	8	35-98	28	-	55-70	-	0.6	.2
Chem. Prods. Div.	0.27	12-40	17-53	0-1	-	85-92	-	7	1.0
Engine Plant	1.1	20	27	0-17	5	72-104	4.7	31-77	.1
Dana Corp.	0.38	3-320	124-139	-	-	-	19-47	2-138	
E.I. DuPont de Nemours & Co.	1.4	1	48-55	0-42	24	32-278	13	0-7	3.1

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TABLE 9-?. SUMMARY O[illegible]

WASTE EFFLUEN[illegible]

[illegible]	[illegible] mg/l	[illegible] mg/l	[illegible] μ	Iron [illegible]	pH	[illegible]-N mg/l	Phosphate mg/l	[illegible] mg/l	Alkalinity mg/l	Acid mg/l	Cyanides mg/l	Copper mg/l	Cadmium mg/l
39	46-99	8	[illegible]-68	11.6	7.1-7.[illegible]	-	-	28-50	28-33	5-1,300	0	0.31	0.06-0.17
61	[illegible]-55	4900-[illegible]	.11-.07	6.6-[illegible]	150		-	[illegible]-150	34-715	-	0-2	0.15	.01-.06
-	11-26	-	[illegible]-132	2	7.7-8.3	-	-	35	32-38	-	.02-.04	.03-.09	<.01
[illegible]	[illegible]-15700	6.29	6-1050	-	4.8-11.[illegible]	-	-	5-800	187-1300	-	0-.06	.04-.13	<.01-.03
-	24-66	-	[illegible]	-	5.0-7.5	-	-	50-220	40-67	117-1339	0	.08-3.05	<.01
60	14-19	20-40	31-36	.76-8.16	7.4	13.3-15	.07-1.21	270-331	134-136	-	-	-	-
133	9-75	8-30	5-375	.06-84	4.6-[illegible]	.11-4.3	-	20-170	32-100	123-176	0-.74	.02-2.2	<.01
421	9-99	4-9	8-100	.5-11.7	7.1-[illegible]	.1-1.16	-	40-220	75-87	-	0	<.01-.02	<.01
-	53-111	-	63-83	-	5.4-6	-	-	230-330	25-33	-	0	.26-.37	<.01
000	14-15000	10-18	6-460	-	[illegible]	-	-	40	137-3063	-	-	.07-.08	<.01
-	5-7	5-6	5-6	0.6	7.0-7.1	-	-	11	45-58	-	-	6.3-9.15	<.01
220	11-326	6-41	3-2500	1.4-15	6.7-8.8	.19-5.1	-	50-270	63-176	-	0-1.14	.03-.07	<01-.05
27	8-21	8-57	1-380	.35-1.07	7.1-8.6	.10-6.5	-	35-100	51-94	-	0-.06	<.01-.09	<.01-.03
132	1-18	14-200	0-9	.15-.78	6.6-8.2	0-.06	-	70-180	41-51	-	0-.01	.04-6.1	<01-0.1
22	8-96	5-15	6-14	.65-1.32	7.8-8.2	.06-0.2	.02-.20	50-100	75-95	-	0	.01-.04	<.01
-	55-70	-	4.6	.21-1.02	7.5-7.	-	-	150-180	97-110	-	23	<.01-.01	<.01
-	55-58	-	7	1.20-1.38	7.4-7.7	-	-	210-220	106-129	-	-	.03-.04	<.01
5	72-104	4.7	31-77	.14-.22	7.5-8.2	-	-	170-250	6-50	-	-	.03-.05	<.01
-	-	19-47	2-130	6-57	-	-	-	50-300	-	-	-	<.01-.50	<.01
4	32-270	13	0-7	3.17-22	2.1-2.5	-	-	240-270	-	-	0	<.01-.08	<.01-.02

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TABLE 9-V. SUMMARY OF RANGES OF AVERAGE RESULTS OF INDUSTRIAL WASTE EFFLUENT CONCENTRATIONS - DETROIT RIVER

s-te /l	ABS mg/l	Alkalinity mg/l	Acid mg/l	Cyanides mg/l	Copper mg/l	Cadmium mg/l	Nickel mg/l	Zinc mg/l	Lead mg/l	Chromium mg/l
-	20-50	25-89	8-1,050	0	0.31	0.08-0.17	.01-.02	.02-.63	.03-.09	.01-.02
-	50-190	34-715	-	0-2	0.15	.01-.06	<.01-.01	.01-.11	.02-.04	.01-.07
-	30	82-92	-	.01-.04	.03-.09	<.01	<.01-.01	.06	.03-.06	.01
-	0-250	187-1380	-	0-.08	.04-.13	<.01-.03	<.01-.03	<.01-.22	.02-.27	<.01-.14
-	50-220	48-67	117-1539	0	.08-3.05	<.01	<.01-.02	.16-.39	.06-.27	<.01-.01
1.15	270-330	134-136	-	-	-	-	-	.11-.14	.09-.13	<.01
-	20-170	32-100	123-176	0-.74	.02-2.2	<.01	<.01-.15	.02-.12	<01-.14	<.01-.74
-	40-210	70-87	-	0	<.01-.02	<.01	<.01-.01	<.01-.04	.06-.90	<.01-.04
-	230-350	29-33	-	0	.26-.37	<.01	<.01	.02-.75	.03-.06	<.01-.19
-	40	137-8563	-	-	.07-.08	<.01	.01-.02	<01-.07	.03-.21	<.01-.26
-	10	45-58	-	-	6.3-9.15	<.01	<.01	1.2-7.05	<01-.08	.93-1.5
-	50-270	63-176	-	0-1.14	.03-.07	<01-.05	<.01-.09	.06-2.38	.12-1.59	<.01
-	30-100	81-94	-	0-.06	<.01-.09	<.01-.03	.01-.03	<.01-.05	.02-.03	<.01-.01
-	70-120	41-91	-	0-.01	.04-6.1	<01-0.1	<.01-.32	.34-4.1	.04-.35	<.01-2.3
.20	50-100	75-95	-	0	.01-.04	<.01	<.01	.05-5.9	<.01-.05	<.01
-	150-180	97-110	-	23	<.01-.01	<.01	.02-.03	.04-.05	<.01-.06	<.01
-	210-220	106-129	-	-	.03-.04	<.01	.01-.02	.06-.24	<.01-.01	<.01-.01
-	170-250	6-80	-	-	.03-.05	<.01	.01	.06-.07	.16-.25	<.01-.01
-	50-300	-	-	-	<.01-.50	<.01	<.01-.02	<.01-4.7	<.01-.13	<.01-.80
-	240-270	-	-	0	<.01-.08	<.01-.02	<.01-.03	1.10	.01-.07	.04-.06

Industry	Flow MGD	BOD mg/l	COD mg/l	Susp. Sol. mg/l	Sett. Sol. mg/l	Chlor-ides mg/l	Oil mg/l	Phenols µg/l	Ir mg
Firestone Tire & Rubber Co.	1.0	7-21	51-455	20-365	12-301	65-125	9-13	19-43	.02
Fuel Oil Corp.	12240*	590	8150	182	0	55	347	130	
Great Lakes Steel									
Ecorse	72	-	10-254	14-119	0-84	23-44	0-165	0-140	.51-
Strip Mill	72	2-6	58-84	15-119	3-107	31-38	6-14	2-14	1.2-
Koppers Company	0.8	25-80	239-315	2-41	0-41	100-261	0-18	5-1360	1.3-
McLouth Steel Corp.									
Trenton Plant	65.7	0-290	-	4-1024	26-800	5-425	0-39	0-119	3
Gibraltar Plant	1.6	6	9-15	17-32	-	85-1835	18	1-80	.02
Mobil Oil Company	1.1	120	216-530	112-257	65	980-15000	69-82	8000-17300	.14
Monsanto Chem. Co.	18	-	46-137	18-143	12	72-80	-	9.6-27	.3-
Pennsalt Chem. Corp.									
East Plant	97	3-17	6-172	19-757	24-124	122-20000	5-8	0-22	
West Plant	6.8	-	80-256	57-162	5-129	212-720	5.1-7	510-1260	.02
Shawinigan Resins & Monsanto Saflex	0.4	1900	606-3619	32-720	-	16-44	6	5.3-11	
Wyandotte Chem. Corp.									
North Plant	57	4-67	80-715	26-706	2-606	32-4910	8-10	0-800	.92-1
South Plant	54.7	4-80	0-1800	34-590	39-225	65-3194	5-15	0-27	
Propylene Oxide Plt	1.0	23-46	402	146-179	-	450-550	-	3-5	.12-

* - gals./hr. when washing ship.

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TABLE 9-V.

INDUSTRIA

Sett. Sol. mg/l	Chlor-ides mg/l	Oil mg/l	Phenols µg/l	Iron mg/l	pH	NH_3-N mg/l	Phos-phate mg/l	ABS µg/l	Alka-linity mg/l	Acid mg/l	Cyanides mg/l	Copper mg/l	Cadm mg/
12-301	65-125	9-13	19-43	.02-470	2.1-8.6	-	-	100-1100	80-132	220-557	-	.10-1.25	<
0	55	347	130	-	8.3	-	-	1080	147	-	-	.06	<
0-84	23-44	0-165	0-140	.51-2240	1.7-8.5	.12-.29	-	30-250	7-115	21-8540	0-.01	.04-1.48	<
3-107	31-38	6-14	2-14	1.2-8.1	7.4-7.8	.09-.57	-	50-150	76-83	-	0-.01	<.01-.04	<.01-
0-41	100-261	0-18	5-1360	1.3-30.5	4.8-7.6	0.1-0.5	-	90-200	26-76	-	.01-.1	.04-2.75	<
6-800	5-425	0-39	0-119	3-64	4.6-10.1	-	-	150-670	80-222	-	0-1.12	<.01-.66	<.01-
-	85-1835	18	1-80	.02-15	3.6-7.7	-	-	152-167	85-88	1100	-	.02-.04	<
65	980-15000	69-828	000-17300	.14-.49	7.4-9.0	-	-	2000-2400	6-179	1900	0	<.01-.14	<.01-
12	72-80	-	9.6-27	.3-.45	7.2-7.3	-	110-240	240-298	108	-	.01	.04-.08	<
4-124	122-20000	5-8	0-22	0	7.5-11.2	.44-16.9	-	0-1100	83-356	-	-	<.01	<.01-
5-129	212-720	5.1-7	510-1260	.02-.05	7.3-10.4	-	-	120-170	71-189	-	-	<.01	<.01-
-	16-44	6	5.3-11	.15	7.1-10.6	-	-	130-555	205-996	1940	-	<.01-.05	<
2-606	32-4910	8-10	0-800	.92-1.33	6.8-11.4	.11-2.3	.04-1.3	20-360	38-560	-	.02-.96	<.01-.24	<.01-
9-225	65-3194	5-15	0-27	3	7.4-9.6	0-1.4	.08-3.03	60-6000	92-1055	-	0-.07	<.01-.41	<
-	450-550	-	3-5	.12-.36	11.7-11.9	-	-	290-470	1053-1080	-	-	.16-.23	<

TABLE 9-V. (CONT.) SUMMARY OF RANGES OF AVERAGE RESULTS OF INDUSTRIAL WASTE EFFLUENT CONCENTRATIONS - DETROIT RIVER

	ABS mg/l	Alkalinity mg/l	Acid mg/l	Cyanides mg/l	Copper mg/l	Cadmium mg/l	Nickel mg/l	Zinc mg/l	Lead mg/l	Chromium mg/l
-	100-1100	80-132	220-557	-	.10-1.25	<.01	<.01-.01	.07-.86	<.01-.06	<.01-.80
-	1080	147	-	-	.06	<.01	<.01	.06	.09	<.01
-	30-250	7-115	21-8540	0-.01	.04-1.48	<.01	.01-.04	.04-.32	.02-.68	.01-.14
-	50-150	76-83	-	0-.01	<.01-.04	<.01-.02	.01-.02	.05-.20	.09-1.6	<.01
-	90-200	26-76	-	.01-.1	.04-2.75	<.01	<.01-8.	.09-1.36	.05-.96	<.01-.04
-	150-670	80-222	-	0-1.12	<.01-.66	<.01-.01	<.01-.21	.01-3	<.01-.74	<.01-.11
-	152-167	85-88	1100	-	.02-.04	<.01	.01	.04-.42	.01-.02	<.01
-	2000-2400	6-179	1900	0	<.01-.14	<.01-.01	<.01-.02	<.01-.18	.08-.64	<.01-.18
0	240-298	108	-	.01	.04-.08	<.01	.01-.03	.04	<.01	<.01
-	0-1100	83-356	-	-	<.01	<.01-.01	<.01-.05	<.01-.08	<.01-.17	<.01-.03
-	120-170	71-189	-	-	<.01	<.01-.02	<.01-.01	<.01-.03	<.01-.02	<.01-.05
-	130-555	205-996	1940	-	<.01-.05	<.01	.02-.08	.01-.29	<.01-.05	<.01
3	20-360	38-560	-	.02-.96	<.01-.24	<.01-.01	<.01-.02	<.01-.36	<.01-.13	<.01-.07
3	60-6000	92-1055	-	0-.07	<.01-.41	<.01	<.01-.02	<.01-.38	<.01-.08	<.01-.09
-	290-470	1053-1080	-	-	.16-.23	<.01	<.01-.01	.08-.44	.10-.13	<.01-.01

INDUSTRY	ROD lbs.	BOD P.E.	Susp. Sol. lbs.	Sett. Sol. lbs.	Chlorides lbs.	Oil gal.	Phenols lbs.	
ROUGE RIVER								
Allied Chemical Corp.								
General Chemical Div.	-	-	1,135	680	456	-	[illegible]	
Plastics Div.	60	360	0	0	12	1.3	[illegible]	
Semet-Solvay Div.	50	300	100	-	150	-	[illegible]	
Solvay Process Div.	0	0	10,000	-	240,000	0	[illegible]	
American Agri. Chem. Corp	0	0	19	-	0	0	0.03	
Darling and Company	[illegible]	42,500	168	90	14	21.6	0.29	
Ford Motor Company	2,930	17,500	62,000	50,000	32,000	900	750	19
American Cement Corp.								
Peerless Cement Div.	25	150	3,000	2,500	367	10	0.27	
Scott Paper Company	135,000	810,000	31,300	-	33,600	-	26	
Sub-Total	145,165	870,810	107,722	53,270	306,587	932.9	810	19
UPPER DETROIT RIVER								
Allied Chemical Corp.								
Solvay Process Div.	0	0	120,000	120,000	450,000	0	1.7	0
Anaconda-American Brass Company	376	2,250	135	-	0	0	0	
Great Lakes Steel Corp.								
Blast Furnace Div.	3,700	22,000	100,000	95,000	17,959	340	370	5,1
Parke Davis Company	17	100	65	0	45	35	1	
Revere Copper & Brass Inc.	570	3,400	2,166	1,500	0	360	0	
U.S. Rubber Company	600	3,600	0	0	2,500	0	0	
Sub-Total	5,263	31,350	222,367	216,500	470,504	735	372.7	5,1
LOWER DETROIT RIVER								
Chrysler Corp.								
Amplex Div.	0	0	168	-	0	0	0	0
Chemical Div.	0	0	0	0	0	0	0	0
Engine Plant	85	510	0	0	268	0	0.78	2
Dana Corporation	588	3,500	0	0	0	8.2	0.26	20

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TABLE 10-V. SUMMARY OF
ADDED BY EA

	Chlorides lbs.	Oil gal.	Phenols lbs.	Iron lbs.	NH_3-N lbs.	Cyanides lbs.	Acid lbs.	Copper lbs.	Cadmium lbs.	Nickel lbs.	Zinc lbs.	Lead lbs.
680	456	-	0.1	-	-	-	0	5	4.1	0	11	1
0	12	1.3	9	0	140	0.6	0	0	0	0	0	0
-	150	-	7.3	0	-	0.35	0	2	0	0	0	0
-	240,000	0	17.5	-	-	0	0	3.6	0	0	2.8	1.5
-	0	0	0.03	-	-	0	0	6.5	0	0	2.0	0.9
0	14	21.6	0.09	-	135	-	0	0	0	0	0	1.0
00	32,000	900	750	19,000	5,000	900	50,000	1,500	0	36	275	50
00	267	10	0.27	6	0	0	0	0	0	0	0	0
	33,600	-	26	-	-	0	0	114	0	0	230	0
70	306,567	932.9	810	19,005	5,205	900.35	50,000	1,631	4.1	36	520.8	54.4
0	450,000	0	1.7	0	-	-	0	0	0	0	0	0
	0	0	0	1.1	-	0	0	60	0	0	32	0.25
0	27,959	340	370	5,146	2,900	10	0	108	0	0	750	123
0	45	35	1	0	-	0.13	0	0	0	0	0	0
0	0	360	0	3.5	-	-	0	100	0	0.4	66	0.9
	2,500	0	0	0	10	0	0	0	0	0	650	0
	470,504	735	372.7	5,150.6	2,910	10.13	0	268	0	0.4	1,432	124.15
	0	0	0	0	-	-	0	0	0	0	0	0
	0	0	0	0	-	-	0	0	0	0	0	0
	268	0	0.78	2	-	0	0	0.4	0	0.1	0.7	2
	0	8.2	0.26	20	-	-	-	1.2	0	0	11	0.5

TABLE 10-V. SUMMARY OF AVERAGE DAILY LOADING OF INDUSTRIAL WASTES ADDED BY EACH INDUSTRY TO DETROIT RIVER

	Acid lbs.	Copper lbs.	Cadmium lbs.	Nickel lbs.	Zinc lbs.	Lead lbs.	Chromium lbs.	Phosphates lbs.
	0	5	4.1	0	11	1	0	-
.6	0	0	0	0	0	0	0	-
35	0	2	0	0	0	0	0	-
	0	3.6	0	0	2.8	1.5	0.4	-
	0	6.5	0	0	2.0	0.9	-	-
	0	0	0	0	0	1.0	0	5.5
0	50,000	1,500	0	36	275	50	260	-
	0	0	0	0	0	0	0	-
	0	114	0	0	230	0	0	-
95	50,000	1,631	4.1	36	520.8	54.4	260.4	5.5
	0	0	0	0	0	0	0	-
	0	60	0	0	32	0.25	10	-
10	0	108	0	0	750	123	0	-
13	0	0	0	0	0	0	0	-
	0	100	0	0.4	66	0.9	29	-
	0	0	0	0	650	0	0	22.5
13	0	268	0	0.4	1,432	124.15	39	22.5
	0	0	0	0	0	0	0	-
	0	0	0	0	0	0	0	-
	0	0.4	0	0.1	0.7	2	0	-
	-	1.2	0	0	11	0.5	1.3	-

INDUSTRY	BOD lbs.	BOD P.E.	Susp. Sol. lbs.	Sett. Sol. lbs.	Chloride lbs.	Oil gal.	Phenols lbs.	Iro lbs
E.I. duPont de Nemours & Company	0	0	0	0	1,500	0	0	
Firestone Tire & Rubber Company	70	420	296	243	16	0	0.19	5,
Fuel Oil Corp.	(1) 221	(1) 1,320	(1) 70	-	(1) 20	17(2)	0	0
Great Lakes Steel								
Strip Mill	350	2,100	29,000	24,400	1,000	375	1.65	1,5
Ecorse	-	-	8,400	6,800	1,800	1,080	1.67	49,0
Koppers Company	112	670	25	24	158	2.4	0.6	
McLouth Steel Corp.								
Gibraltar Plant	0	0	-	-	25,600	33	0	2
Trenton Plant	5,000	30,000	15,588	9,200	24,267	37	9.04	1,9
Mobile Oil Company	1,000	6,000	1,588	-	12,989	98.5	117	
Monsanto Chem. Corp.	-	-	6,500	-	0	-	0	
Pennsalt Chem. Corp.								
East Plant	-	-	93,370	70,000	500,000	-	0	
West Plant	-	-	6,500	5,200	8,779	41.5	60	
Shawinigan Resins	6,970	42,000	1,313	-	0	-	0.01	
Monsanto Chem. Corp. Saflex Div.	79	423	34	-	0	-	0	
Wyandotte Chem. Corp.								
North Plant	2,200	13,200	300,000	255,000	1,300,000	-	34.13	-
South Plant	3,000	18,000	69,745	35,000	63,970	-	0	-
Propylene Oxide Plant	250	1,500	1,248	-	3,900	-	-	
Sub-Total	19,704	118,323	533,845	405,867	1,944,247	1,676	225.33	56,174
Total Detroit River (3)	170,000	1,020,000	864,000	676,000	2,720,000	3,340	1,400	82,300

(1) lbs/ship
(2) gal/ship
(3) Rounded to three significant figures

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TABLE 10-V. (CON

WASTE

Sett. Sol. lbs.	Chloride lbs.	Oil gal.	Phenols lbs.	Iron lbs.	NH_3-N lbs.	Cyanides lbs.	Acid lbs.	Copper lbs.	Cadmium lbs.	Nickel lbs.	Zinc lbs.
0	1,500	0	0	23	-	0	-	0.3	0	0	6
243	16	0	0.19	5,407	-	-	2,700	13	0	0	9
-	(1) 20	17(2)	0	0	-	-	0	-	-	-	-
24,400	1,000	375	1.65	1,500	86	0	0	0	0	0	42
6,800	1,800	1,080	1.67	49,000	-	-	158,000	137	0	4	12
24	158	2.4	0.6	13	-	0	0	2.7	0	0	2.8
-	25,600	33	0	210	-	-	15,400	-	-	-	-
9,200	24,267	37	9.04	1,990	250	119	0	63	0	9	300
-	12,989	98.5	117	2	-	.	0	0.7	0	0	0.5
-	0	-	0	6	-	-	-	3.5	0	0.8	0.4
70,000	500,000	-	0	0	-	-	0	0	0	0	0
5,200	8,779	41.5	60	0	-	-	0	0	0	0	0
-	0	-	0.01	0	-	-	7,190	0	0	0	0
-	0	-	0	-	-	-	0	0	0	0	0
255,000	1,300,000	-	34.13	-	-	-	0	59	0	0	7
35,000	63,970	-	0	-	-	-	0	35	0	1	10
-	3,900	-	-	1	-	-	0	1.3	0	0	1.8
405,867	1,944,247	1,676	225.33	58,174	336	119	185,890	317	0	15.0	403.2
676,000	2,720,000	3,340	1,400	82,300	8,520	1,030	235,000	2,220	4.1	51	2,360

TABLE 10-V. (CONT.) SUMMARY OF AVERAGE DAILY LOADING OF INDUSTRIAL WASTES ADDED BY EACH INDUSTRY TO DETROIT RIVER

Acid lbs.	Copper lbs.	Cadmium lbs.	Nickel lbs.	Zinc lbs.	Lead lbs.	Chromium lbs.	Phosphates lbs.
-	0.3	0	0	6	0.4	0	-
2,700	13	0	0	9	0	0	-
0	-	-	-	-	-	-	-
0	0	0	0	42	280	0	-
158,000	137	0	4	12	34	8	-
0	2.7	0	0	2.8	1.2	0	-
15,400	-	-	-	-	-	-	-
0	63	0	9	300	325	3	-
0	0.7	0	0	0.5	3	0.8	-
-	3.5	0	0.8	0.4	0	0	10,000
0	0	0	0	0	0	0	-
0	0	0	0	0	0	0	-
7,190	0	0	0	0	0	0	-
0	0	0	0	0	0	0	-
0	59	0	0	7	0	0	14
0	35	0	1	10	7	6	14
0	1.3	0	0	1.8	0.4	0	-
185,890	317	0	15.0	403.2	653.5	19.1	10,028
235,000	2,220	4.1	51	2,360	832	318	10,100

TABLE 11-V. SOURCES OF INDUSTRIAL WASTES - ROUGE RIVER

Industry	Volume (MGD)	Product	Production	Significant Waste Constituents	Waste Treatment or Control
Allied Chemical Corporation					
General Chemicals Division	9.11	sulfuric acid, aluminum sulphate.	-	acid	ponds, pH monitors.
Plastic Division	0.48	coal tar, pitch, oil.	-	phenols, NH_3	dephenolizers, settling, oil separators.
Semet-Solvay Division	5.9	high-grade coke and by-products	-	phenols	dephenolizer, oil separator
Solvay Process Division	15.2	soda ash	1,000 ton/day	suspended solids, chlorides, phenols	lagoons
American Agricultural Chemical Company	1.15	fertilizer, gelatin, fluoride salts	-	acid	none
Darling and Company	1.13	fats and meat meal	-	BOD, coliform, N, suspended solids, oil	sedimentation
Ford Motor Company	400	steel, castings, coke, glass, automobiles	-	phenols, CN, NH_3, iron, oil	oil separator, sedimentation, sub-surface injection.
Peerless Cement Company	8.1	Portland cement	3 1/4 million barrels/year	suspended solids	none
Scott Paper Company	43.8	high-grade paper tissue	240 tons/day	BOD, pH, Susp. solids, phenols.	screening, clarifiers
TOTAL	433.72				

TABLE 12-V. SOURCES OF INDUSTRIAL WASTES - UPPER DETROIT RIVER

Industry	Volume (MGD)	Product	Production	Significant Waste Constituents	Waste Treatment or Control
Allied Chemical Corporation					
Solvay Process Division	6.4	soda ash	1,000 tons/day	suspended solids, chlorides, phenols	lagoons
Anaconda-American Brass Company	5.3	copper	-	toxic metals, acid	neutralization, settling
Great Lakes Steel Corporation					
Blast Furnace Division	90	coke, pig iron, coke by-products	-	iron, susp. sol., phenols, oil, NH_3, cyanides	clarifiers, dephenolizer
Parke Davis and Company	8.1	pharmaceuticals	-	none	none
Revere Copper and Brass Company	2.9	brass and copper	-	oil, toxic metal	oil separators
U.S. Rubber Company	42	tires	-	none	oil skimmers
TOTAL	154.7				

TABLE 13-V. SOURCES OF INDUSTRIAL WASTES - LOWER DETROIT RIVER

Industry	Volume (MGD)	Product	Production	Significant Waste Constituents	Waste Treatment or Control
Chrsyler Corporation Amplex Division	0.32	gears	-	none	none
Chemical Products Division	0.27	chemical adhesives, brake linings, soluble oils	-	none	none
Engine Plant	1.1	engines	55,000/mo.	oil	air flotation and oil skimmer, chemical coagulation
Dana Corporation	0.38	auto and truck frames, trilevel RR car carriers	-	phenols, acid, oil, iron	none
E.I. duPont deNemours and Company	1.4	sulfuric acid, oleum	-	acid	none
Firestone Tire and Rubber Company	1.0	wheel rims	11,400,000 lbs./mo.	acid, iron, oil, suspended solids	oil separator, ponds, diffuser pipes
Fuel Oil Corporation	12,240*	ship washing	18 ships/yr.	oil, suspended solids	oil separator
Great Lakes Steel Corporation Hot Strip Mill	72	sheet steel	-	oil, iron, suspended solids	oil skimmers and settling basins
Rolling Mill	72	strip, sheet and bar steel	-	oil, phenols, acid, iron, suspended solids	oil separators

* gallons per hour when washing ship.

TABLE 13-V – Continued

Industry	Volume (MGD)	Product	Production	Significant Waste Constituents	Waste Treatment or Control
Koppers Company, Incorporated	0.8	naphthaline, paraffin epoxy resins	-	phenols, oil	none
McLouth Steel Corporation					
Girbraltar Plant	1.6	cold rolled steel	80,000 tons/mo.	acid, iron, suspended solids, oil	oil skimmers, lagoons
Trenton Plant	65.7	stainless steel	2,530,000 tons/yr.	iron, suspended solids, oil	chemical coagulation, settling neutralization, oil separators
Mobil Oil Corporation	1.1	gasoline, naptha, kerosine, oils	-	phenols, oil, chlorides, suspended solids	oil separator, ponds
Monsanto Chemical Company	18	phosphates and detergent	-	phosphates, suspended solids	lagoons
Pennsalt Chemicals Corporation					
East Plant	97	chlorine, caustic, NH_3, hydrogen peroxide, acid, ferric chloride	-	NH_3, chlorine, chlorides, suspended solids	none
West Plant	6.8	organic chemicals	-	phenols, chlorides, suspended solids, oil, oxidizing agents	lagoons, oil skimmers
Shawinigan Resins Corporation and Monsanto Saflex Division	0.4	polyvinyl butyral Ethyl acetate	500,000 lbs/week	acid, BOD, suspended solids	lagoons, neutralization

TABLE 13-V – Continued

Industry	Volume (MGD)	Product	Production	Significant Waste Constituents	Waste Treatment or Control
Wyandotte Chemicals Corporation					
North Plant	57	soda ash, bicarb of soda, lime, calcium carbonate, cellulose	-	phenols, chlorides, suspended solids, nitrogen	lagoons
South Plant	54.7	chlorine, lime, glycol, cement, soda, dry ice	-	chlorides, suspended solids, phenols	lagoons, oil separator
Propylene Oxide Plant	1.0	propylene oxide	65 tons/day	chlorides, suspended solids	lagoons
TOTAL	452.57				

TABLE 14-V. INDUSTRIAL WASTE LOADINGS BY AREA - DETROIT RIVER

Area	BOD (lbs)	BOD (PE)	OIL (gallons)	IRON (lbs)	Susp. Solids (lbs)
Rouge River	145,000	871,000	933	19,000	108,000
Upper Detroit River	5,260	31,400	735	5,150	222,000
Lower Detroit River	19,700	118,000	1,680	58,200	534,000
Total	169,960	1,020,400	3,348	82,350	864,000

Area	Cyanides (lbs)	Phenol (lbs)	Chlorides (lbs)	Ammonia (lbs)	Toxic Metals (lbs)	Acid (lbs)
Rouge River	900	810	307,000	5,280	2,040	50,000
Upper Detroit River	10	373	470,000	2,910	1,950	0
Lower Detroit River	119	225	1,940,000	336	1,200	185,900
Total	1,029	1,408	2,717,000	8,526	5,190	235,900

TABLE 15-V. INDUSTRIAL EFFLUENTS CONTAINING HIGH

CONCENTRATIONS OF WASTE MATERIALS AND VALUES OF PHENOLS, pH, OIL, AND IRON EXCEEDING IJC EFFLUENT RECOMMENDATIONS

Rouge River	Phenols (µg/l)	pH	Oil (mg/l)	Chlorides (mg/l)	Susp.Sol. (mg/l)	Sett.Sol. (mg/l)	Iron (mg/l)	BOD (mg/l)
Allied Chem. Corp.								
Solvay Process Div.								
Waste Pond No. 3	750	11.1		100,000	234	44		
" " No. 2	415	11.0		115,000	216			
Sewer No. 1	45							
" No. 3	55				166			
Plastics Div.	8,750							950
Darling & Co.			50		110			830
Scott Paper Co.	73				97			372
Peerless Cement					331	272		
Ford Motor Co.								
Gate 11			23			51		
Tailrace	375							
Roulo Creek		4.6			171	133	28	
Foundry	2,248				102	87		

Almost all of the eight outfalls contained phenols above the recommended limit of 0.020 mg/l, and suspended solids were concentrated enough to discolor the River in a trail close to the shoreline. The suspended solids were primarily made up of readily settleable material. Approximately 1,000 pounds per day of toxic metals are lost to the Detroit River with 700 pounds of this being zinc.

The Allied Chemical-Solvay Process outfall, located below the Blast Furnace complex, discharged 54% of the suspended solids and 96% of the chlorides to this reach of the River. This one outfall, although small in flow, contained the largest concentration of wastes observed during the study even though the flow passed through a sedimentation pond.

The Revere Copper and Brass Company waste effluent discharged 360 gallons of oil per day, which represents over half the amount of oil released in the upper River.

The waste effluents from Parke Davis, Anaconda-American Brass Company, and U.S. Rubber Company have only limited effect on water quality. However, the U.S. Rubber Company discharges 650 pounds per day of zinc to the Detroit River.

Table 17-V lists those industries in the lower Detroit River whose effluent discharge is considered to contain certain waste constituents in high concentrations.

During stream sampling activities in the lower Detroit River many visual observations and laboratory determinations were made by Project personnel which indicate the effect of specific industries upon water quality in the River. These include:

1. The Great Lakes Steel Hot Strip Mill effluent contains oil which leaves a film on the water surface. Significant quantities of suspended iron can be seen discoloring and hugging the shoreline below the outfalls.

2. Thick mats of oil have been observed on the water surface near the Great Lakes Steel Rolling Mill and traced to their oil separator outfalls. Pickle liquor wastes containing 158,000 pounds per day sulfuric acid and 40,000 pounds per day dissolved iron are released at the downstream edge of the steel works, and the effects of this can be observed in the vicinity of Mud Island and Ecorse Channel where the oxidized iron exhibits a noticeable red color to the water.

3. Detroit River water is discolored by calcium chloride and calcium carbonate wates of the Wyandotte Chemical Company North Works.

4. Increased chloride concentrations were found at shoreward sampling stations in reaches below both Wyandotte factories and the Pennsalt East Plant. In fact, these three factories contribute approximately 27 per cent of the chloride flow in the Trenton Channel.

5. Lower densities of coliform bacteria and attached aquatic alga at shoreward stations in the vicinity of the two Grosse Ile bridges were presumably caused by the loss of strong oxidizing agents from the Wyandotte and Pennsalt Chemical Plants.

6. Patches of oil and floating solids in Monguagon Creek originated from the Pennsalt West Plant.

7. Nearly one-half of the Trenton Channel was discolored by the suspended iron passing over the effluent weirs of the McLouth Steel Trenton Plant clarifiers. In fact, results of samples collected three times a day, tested for suspended solids and iron by the McLouth Steel personnel, and furnished to the Michigan Water Resources Commission at their request, demonstrate ineffective waste control in that both constituents exceed the Michigan Water Resources Commission prescribed limits approximately one-half the time. The most recent records do reveal better and more consistent operation of existing waste facilities. From the standpoint of

TABLE 16-V. INDUSTRIAL EFFLUENTS CONTAINING HIGH

CONCENTRATIONS OF WASTE MATERIALS AND VALUES OF PHENOLS, pH, OIL AND IRON EXCEEDING IJC EFFLUENT RECOMMENDATIONS

Upper Detroit River	Phenols (µg/l)	pH	Oil (mg/l)	Chlorides (mg/l)	Susp.Sol. (mg/l)	Sett.Sol. (mg/l)	Iron (mg/l)	BOD (mg/l)
Revere Copper and Brass Co.								
Outfall No. 1			146		115	81		
Outfall No. 2						44		
Allied Chem. Corp.								
Solvay Process Div. Cone Effluent	445	11.0		185,000	11,500	11,500		
Great Lakes Steel								
Blast Furnace Div.								
Outfall No. 2	1,150				95	95	20	
" No. 3					172	172	35	
" No. 4	68		37		185	180	16	
" No. 4A	410					82		
" No. 5					144	143	49	
" No. 6	1,250					42		
" No. 7					176	174		
" No. 8	176				240	220		
Parke-Davis								
Outfall No. 1						15		
" No. 2						15		
" No. 3						27		

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TABLE 17-V. INDUSTRIAL EFFLUENTS CONTAINING HIGH

CONCENTRATIONS OF WASTE MATERIALS AND VALUES OF PHENOLS, pH, OIL, AND IRON EXCEEDING IJC EFFLUENT RECOMMENDATIONS

Lower Detroit River	Phenols (µg/l)	pH	Oil (mg/l)	Chlorides (mg/l)	Susp.Sol. (mg/l)	Sett.Sol. (mg/l)	Iron (mg/l)	BOD (mg/l)
Chrysler Corp.								
Engine Div.	81							
Dana Corp.								
Outfall No. 1			47				57	
Outfall No. 3	138		23					320
E. I. duPont de Nemours & Co.		2.3				24		
Firestone Tire & Rubber Co.								
Ash Pit					365	301		
Outfall No. 3		2.5					470	
Fuel Oil Corp.			347					590
Great Lakes Steel Corp.								
Hot Strip Mill								
Sewer No. 1					90	75		
Rolling Mill								
Outfall No. 1						44		
Pickle Liquor		1.7					2240	
Outfall No. 2			32		119	74	50	
Outfall No. 3		4.0				49	67	
Outfall No. 4			28			28		
Outfall No. 11			165			27		
Outfall No. 7						26		

TABLE 17-V. INDUSTRIAL EFFLUENTS CONTAINING HIGH

CONCENTRATIONS OF WASTE MATERIALS AND VALUES OF PHENOLS, pH, OIL, AND IRON EXCEEDING IJC EFFLUENT RECOMMENDATIONS (Cont.)

Lower Detroit River	Phenols (µg/l)	pH	Oil (mg/l)	Chlorides (mg/l)	Susp.Sol. (mg/l)	Sett.Sol. (mg/l)	Iron (mg/l)	BOD (mg/l)
Koppers Co.								
Sewer No. 2	1360					29		
Sewer No. 3						41		
Monsanto Chem. Co.								
Mobil Oil Co.	12500		82	1500				120
Pennsalt Chem. Corp.								
East Plant								
Outfall No. 1						42		
Outfall No. 2					113	113		
Outfall No. 3								
Outfall No. 4					147	124		
Wye St.				788	18.0			
Perchloron Plant				19750	741			
West Plant	6550				137	99		
Wyandotte Chem. Corp.								
North Plant								
Outfall No. 1				3165	706	606		
Outfall No. 2					119	50		
Outfall No. 2A	585							
Outfall No. 3	76			2780	114			
Outfall No. 4	292							
Outfall No. 4A	35				107			

TABLE 17-V. INDUSTRIAL EFFLUENTS CONTAINING HIGH

CONCENTRATIONS OF WASTE MATERIALS AND VALUES OF PHENOLS, pH, OIL, AND IRON EXCEEDING IJC EFFLUENT RECOMMENDATIONS (Cont.)

Lower Detroit River	Phenols (µg/l)	pH	Oil (mg/l)	Chlorides (mg/l)	Susp.Sol. (mg/l)	Sett.Sol. (mg/l)	Iron (mg/l)	BOD (mg/l)
Wyandotte Chem. Corp.								
South Plant								
Outfall No. 1						39		
" No. 2				3194	275	144		
" No. 3				1977	590	225		
" No. 4					189	103		
Propylene Oxide Plant		11.8			163			
McLouth Steel Corp.								
Gibraltar Plant		3.6		1835				
Trenton Plant								
Outfall No. 1						27	64	
" No. 2						34		
" No. 3					608	600		
" No. 4						26	35	
Shawinigan Resins Corp.								1900

removal of suspended solids, this is evidenced by the fact that during the last 2 months of available operating records, the limitations imposed by the Michigan Water Resources Commission were exceeded only 2 per cent of the time. Iron concentration in the effluent exceeded Commission requirements less than 1 per cent of the time during this period.

8. There were profuse growths of aquatic weeds in the lower Trenton Channel near the phosphate-enriched outfall of the Monsanto Chemical Plant.

9. Sludge deposits and layers of accumulated sediments were in boat slips and other areas where the velocity of flow is retarded sufficiently to permit settling.

10. Globules of oil and iron deposits in the Frank and Poet Drain near the town of Gibraltar were presumably caused by the wastes of the McLouth Steel Gibraltar Plant.

11. Concentrated iron deposits were found in the vicinity of the waste pickle liquor outlet of the Firestone Tire and Rubber Company.

12. Foaming problems in the lower Trenton Channel were traced to accidental spills of detergent from Monsanto Chemical Company.

13. These industries and also the Mobil Oil Corporation release phenols which exceed the IJC effluent recommendations.

14. Toxic metals in amounts of 325 and 700 pounds per day are emptied into the River by the Great Lakes Steel Hot Strip Mill and McLouth Steel Trenton Plant. Lead is the principal metal from the Strip Mill, while zinc and lead comprise most of metal lost from McLouth.

15. Shawinigan Resins discharges 7,000 pounds of BOD daily to the lower Detroit River, which places a demanding load on the oxygen resources of the River. However, a settling lagoon was installed by this company after the survey which may change the amount of BOD discharged from this plant.

16. There was an increase in hardness of approximately 25 mg/l between the upper and lower Detroit River, with the principal contributors being the soda ash plants at Pennsalt Chemical Corporation, Wyandotte Chemical, and Allied Chemical Corporation.

These factors and many others which go undetected severely limit the use of the water resources in the downriver area.

The table below lists reductions in industrial waste loadings in the Detroit River that could be achieved if excessive concentrations of certain constituents were reduced by effective treatment or management to meet International Joint Commission effluent recommendations and a suspended solids effluent limit of 35 mg/l.

Waste Constituent	Present Loading	Loadings after Reduction	Per cent Reduction
Iron	82,300 pounds/day	24,800 pounds/day	70
Oil	3,340 gallons/day	1,900 gallons/day	43
Phenols	1,400 pounds/day	80 pounds/day	94
Suspended Solids	864,000 pounds/day	150,000 pounds/day	83

In the Rouge River a reduction of the load reaching the Rouge River, of 50 per cent of the suspended solids, 37 per cent of the iron, 94 per cent of the phenols, and 2 per cent of the oil would result. In order to effect an additional reduction in oil loadings to the Rouge, an internal plant program would have to be inaugurated to prevent oil from reaching plant drains.

In the upper Detroit River suspended solids could be reduced 98 per cent, phenols 96 per cent and oil 64 per cent.

In the lower Detroit River suspended solids would be reduced 81% to 97,000 pounds per day; iron 87% to 7,600 pounds per day; oil 57% to 723 gallons per day; and phenols 91% to 20 pounds per day.

Industries which are under restrictions by the Michigan Water Resources Commission because of excessive discharges of wastes are McLouth Steel - Gibraltar (pH), McLouth Steel - Trenton (iron and suspended solids), Mobil Oil Corporation (phenols and oil), Ford Motor Company - Rouge Plant (phenols), Pennsalt Chemical Corporation - West Plant (phenols), Fuel Oil Corporation (oil), Darling and Company (coliform bacteria, BOD), Scott Paper Company (phenols, BOD, suspended solids), E. I. duPont de Nemours and Company (pH), Firestone Tire and Rubber Company (iron, pH), and Great Lakes Steel Corporation - Hot Strip Mill (suspended solids, oil).

Other Waste Sources

Stormwater Overflow

The majority of the sewered areas in the study area utilize combined sewers in which storm and sanitary wastes are carried. During periods of significant rainfall, these sewers discharge, without treatment, a combination of stormwater and domestic sewage directly to the receiving stream. As indicated by the water use inventory in this report, over 100 such points of overflow are located along the Detroit River and represent a significant source of waste during wet conditions.

Due to the magnitude of the effect of this waste an extensive evaluation was undertaken by the Project and is discussed under "Special Studies" in this section of the report.

Pollution from Boats

In the Public Health Service report for the 1962 conference it was stated that over 125,000 pleasure boats were registered in the Detroit area, and the water use inventory of this report lists numerous marina facilities and describes the magnitude of the commercial shipping industry in this area. All boats, when used in the waters under study, represent potential sources of pollution from human wastes.

Estimates of the magnitude of these sources have not been made because the following information was unavailable or inadequate:

1. Number of boats in the water at any one time or at any one location.

2. Length of average cruise, to ascertain probability of use of waste disposal facilities.

3. Number or percentage of vessels having adequate waste treatment facilities.

The State of Michigan recently adopted legislation amending the Public Acts of 1931 to prevent the discharge of garbage to a river or inland lake of Michigan or within 3 miles of the shoreline of any part of the Great Lakes or connecting waters thereof in Michigan unless it has passed through a disposal unit approved by the U.S. Public Health Service. The legislation authorizes a fine of not more than $1,000 or imprisonment for not more than one year or both.

The U.S. Corps of Engineers has certain responsibilities relating to discharge of deleterious material into navigable waters from boats, and these are described in the section IV of this report.

Shorefront Homes

Estimates of the number of unsewered shorefront homes that discharge sewage directly or from improperly functioning septic tanks to the Detroit River were made in the 1962 conference report. The majority of these homes are located on Grosse Ile, and a special study was performed to determine the effect of this source of pollution on water quality and use. A report of this survey is made under "Special Studies" in this section of the report.

SPECIAL STUDIES

During this Project a number of special studies or investigations were made to collect additional information which might furnish insight into the relationship of sources of wastes to water quality in the receiving streams. Descriptions of the nine studies follow.

Stormwater Overflow

Combined sewers carrying both domestic waste and surface runoff are used in the Detroit metropolitan area as well as most of the large metropolitan areas of this nation. During periods of significant rainfall these sewers discharge a combination of raw sewage and storm runoff directly to the receiving stream (in this case the Detroit River) without treatment of any kind. The effect of this operation upon water quality in the Detroit River and possible interference with water use downstream was of great concern to Project personnel, and special studies to provide appropriate facts were undertaken.

The problem was attacked in two ways. First, a cooperative study with State of Michigan regulatory agencies was set up to measure the frequency, duration, volume, and strength of the overflows at the point of overflow. Secondly, a special stream sampling program on the Detroit River was established to collect bacteriological samples during and after heavy rainfall. These were compared with dry weather values found at each sampling location.

Characteristics of Overflows from Combined Sewers

Special samplers were designed and fabricated and placed at the point of overflow in the Conners Creek sewer system, which serves approximately 25 percent of the City of Detroit. The samplers were completely automatic, activating and deactivating at the beginning and end of an overflow. The samples were collected by Project personnel and analyzed at Public Health Service laboratory facilities. Determinations made include total coliform, fecal coliform, and fecal streptococcus on individual samples; and a limited number of phosphates, nitrogen compounds, suspended solids, and BOD and phenol determinations on composite samples representing an entire storm.

Water level recorders were installed at each location and extra rainfall gages installed to provide adequate precipitation data. A control study was also made in similar manner at the Allen Creek drainage system in the City of Ann Arbor to determine similar characteristics of discharge from separate storm sewers.

A special factual summary of the results of this investigation was prepared by the Michigan Department of Health. This report lists average and extreme bacteriological results and the duration of each overflow. The report estimates the volume of overflow discharged into the Detroit River following each storm. Generally speaking, accumulated precipitation of 0.3 inch will cause an overflow at the Conners Creek installation and 0.2 inch will cause an overflow at the Conant-Mt. Elliot relief sewer.

Additional summaries of the results of this investigation were made to emphasize certain findings. Table 43-V lists pertinent facts concerning the number of overflows at Detroit during the first year's operation of the sampler (excluding the 10-day period of raw sewage by-pass at the Conners Creek pumping station) and the duration of overflows. Figure 47-V summarizes 20-year rainfall records for the Detroit area by showing the number of days per year rain of specific intensity and accumulation could be expected. Table 44-V summarizes bacteriological results at the separate storm overflow at Ann Arbor. Table 45-V shows the average composite results of BOD, solids, nutrients, and phenols at the three installations, while Table 46-V summarizes bacteriological results at the three stations by 2-month intervals.

Careful study of the data and individual results provided the basis for the following conclusions:

1. Total coliform, fecal coliform, and fecal streptococcus densities in the overflow from combined sewers many times approached values found in raw sewage. Coliform counts of over 100,000,000 per 100 ml were found during summer months.

2. Bacterial densities in the combined overflows varied greatly with the season or time of the year. The highest densities were found during warmer weather and lowest results in the winter.

3. Total coliform densities in the separate system at Ann Arbor regularly exceeded 1,000,000 per 100 ml. Average total coliform densities in the overflows from the Detroit combined system were approximately 10 times higher than those in Ann Arbor's separate system. Fecal coliform densities in the combined sewer effluent were found to be approximately 30 times greater than similar values in the separate system, while comparable fecal streptococcus levels were at least twice as high.

4. In the Detroit area rainfall sufficient to cause overflows from all combined sewers (0.3 inch) can be expected to occur approximately 33 days each year. Rainfall sufficient to cause overflows from certain parts of the system (0.2 inch) can be expected to occur about 45 days each year.

5. Although the average duration of overflow from combined sewers was found to be 8.2 hours, discharges have occurred for continuous periods in excess of 24 hours. Two such overflows occurred during the month of August 1964.

6. Suspended solids concentration in the discharge from the separate storm installation at Ann Arbor was higher than in the combined overflows at Detroit.

7. Phenol, BOD, phosphate, ammonia, and organic nitrogen concentrations were two to five times higher in the combined overflow than in separate storm discharge.

8. Bacteriological results from the combined installations showed a slight tendency for higher values during the first sample but thereafter were relatively constant throughout the duration of the overflow.

9. Bacteriological results at the Ann Arbor separate system were also comparatively constant during a storm, always remaining within one order of magnitude. Small changes in quality and flow were more noticeable at this installation, however.

10. Calendar year 1963 was the driest on record for the City of Detroit according to rainfall records of the U.S. Weather Bureau. Even during this year, the Conners Creek pumping station was observed to overflow 12 times during a 6-month period in 1963. During the first year of operation of the automatic sampler, the Conners Creek installation overflowed and collected samples 23 separate times. Both figures exclude the period of raw sewage bypass from this station by the City of Detroit.

11. The volume of overflow at the Detroit installation during the survey varied from 40 million gallons to 509 million gallons. The greatest volume was observed during the overflow of longest duration. This volume, which originates from only 25 per cent of the City of Detroit, is approximately the same as the daily discharge of partially treated sewage from all sewage treatment plants into the Detroit River.

12. Volume figures in the joint report indicate a discharge into the Detroit River of 4 1/4 billion gallons from the combined sewers serving the Connor system during the first year of operation of the sampling stations.

TABLE 43-V. OVERFLOWS FROM COMBINED SEWERS
CONNER GRAVITY SYSTEM
CITY OF DETROIT

Location of Installation	Number of Overflows		
	1st Year of Operation*	2nd Year of Operation**	Total
Conners Creek	23	10	33
Jefferson & Leib	31	16	47

Location of Installation	Mean Overflow Duration	Total Accumulated Overflow Time***
Conners Creek	9.85 hours	325 hours
Jefferson & Leib	6.70 hours	314 hours

*At the Conners Creek installation, the first year is considered to extend from the installation date of May 10, 1963, straight through to May 10, 1964; the first year of operation of the Leib installation is considered to extend from the installation date of June 15, 1963 to June 15, 1964, with the exception of the period from December 10, 1963 to March 17, 1964, when it was not in service.

**May 10, 1964 through August 31, 1964 for Conners Creek; June 15, 1964 through August 31, 1964 for Leib.

***Through August 31, 1964.

TABLE 44-V. SUMMARY OF BACTERIOLOGY RESULTS
ANN ARBOR STORM SEWER INSTALLATION

Date of Overflow	Duration of Overflow (Min)	Total Rainfall inches*	Number of Samples	Total Coliform Organisms/100ml			Fecal Coliform Organisms/100ml		
				Geom. Mean	Minimum	Maximum	Geom. Mean	Minimum	Maximum
1964									
4/2-3	-	.75	2	340,000	180,000	640,000	17,000	9,000	32,000
4/21	24	.40	5	116,000	70,000	200,000	10,100	10,000	10,400
4/28	38	.40	8	355,000	210,000	520,000	7,400	4,000	14,000
5/8	11	.25	3	880,000	460,000	2,800,000	73,000	58,000	87,000
5/8	G105	.90	21	139,000	42,000	2,800,000	28,700	10,000	87,000
6/7	16	.25	4	2,100,000	1,030,000	3,200,000	39,000	26,000	56,000
6/7	-	1.0	1	5,500,000	-	-	86,000	-	-
6/12	27	.50	6	4,010,000	3,300,000	5,900,000	78,100	16,000	250,000
6/15	30	.55	7	187,000	120,000	280,000	24,100	14,000	38,000
6/19	4	.60	2	10,200,000	5,500,000	19,000,000	133,000	56,000	320,000
7/2	39	.50	8	2,200,000	120,000	5,100,000	125,000	30,000	240,000
7/2	25	.45	6	4,100,000	2,800,000	5,100,000	G1,500	G1,500	14,000
7/3	14	.45	3	390,000	250,000	840,000	60,000	26,000	142,000
7/20	22	.35	5	3,900,000	2,500,000	6,800,000	435,000	290,000	830,000
7/25	29	.30	6	15,000,000	2,900,000	32,000,000	560,000	14,000	4,300,000
8/3	3	.30	2	1,700,000	500,000	5,800,000	270,000	120,000	600,000
8/11	5	.25	2	5,800,000	4,100,000	8,100,000	680,000	210,000	2,200,000
8/11	33	.40	12	1,200,000	170,000	3,900,000	350,000	20,000	1,700,000
8/11	27	.35	10	220,000	L10,000	1,500,000	165,000	L10,000	1,000,000
8/17	3	.35	2	34,300,000	24,000,000	49,000,000	747,000	360,000	1,550,000
8/22	15	.35	6	920,000	610,000	2,000,000	340,000	300,000	380,000
8/28	33	.55	12	8,500,000	3,500,000	22,000,000	570,000	200,000	1,300,000

*PHS raingage - Ann Arbor water treatment plant

TABLE 44-V. SUMMARY OF BACTERIOLOGY RESULTS ANN ARBOR STORM SEWER INSTALLATION (CONTINUED)

Date of Overflow	Fecal Streptococci Organisms/100ml			Composite Results per Overflow				
	Geom. Mean	Minimum	Maximum	Susp. Solids (ppm)	Phenols (ppb)	Phosphates (ppm)	Ammonia N. (ppm)	Organic N. (ppm)
1964								
4/2-3	31,000	25,300	38,500	-	12	-	-	.02
4/21	12,400	7,100	19,700	91	25		.74	.47
4/28	20,100	11,500	32,800	-	7	-	.40	.88
5/8	323,000	264,000	413,000	949	11	2.4	.60	.30
5/8	73,000	36,000	140,000	2,062	1	2.7	.55	.34
6/7	193,000	125,000	336,000	-	-	-	.67	.51
6/7	326,000	-	-	-	-	-	-	-
6/12	124,000	80,000	210,000	-	-	-	-	-
6/15	42,500	30,000	66,000	-	-	-	-	-
6/19	116,000	90,000	150,000	-	-	-	-	-
7/2	190,000	140,000	262,000	-	-	-	.44	.41
7/2	180,000	142,000	237,000	-	-	-	.59	.52
7/3	-	96,000	96,000	-	-	-	-	-
7/20	600,000	310,000	1,000,000	1,544	-	9.5	.45	.49
7/25	670,000	360,000	1,840,000	1,320	10	4.3	.68	.00
8/3	475,000	340,000	660,000	-	-	-	-	-
8/11	260,000	200,000	330,000	-	-	-	-	-
8/11	190,000	130,000	330,000	904	7	2.1	-	.28
8/11	120,000	110,000	400,000	1,066	9	2.0	-	.28
8/17	362,000	320,000	410,000	-	-	-	-	-
8/22	310,000	240,000	400,000	-	-	-	-	-
8/28	330,000	120,000	550,000	-	-	-	-	-

TABLE 45-V. SUMMARY OF COMPOSITE RESULTS COMBINED AND SEPARATE SEWER INSTALLATIONS

Location of Installation	Type of Sewers	Range of Composite Results					
		BOD (mg/l)	Susp. Solids (mg/l)	Phenols (ug/l)	NH_3N (mg/l)	Org. N. (mg/l)	Total PO_4 (mg/l)
Ann Arbor	Separate	29 - 51	91 - 2060	1 - 25	.4 - .7	.00 - .88	.28 - 9.5
Conners Creek	Combined	-	14 - 422	11 - 125	1.3 - 5.1	.16 - .52	1.8 - 13
Leib & Jefferson	Combined	46 - 217	86 - 422	12 - 35	3.2 - 5.9	.21 - 1.09	4 - 24

TABLE 46-V. SUMMARY OF BACTERIOLOGY RESULTS AT SAMPLER INSTALLATIONS BY TWO-MONTH INTERVALS

Period	Analysis	Ann Arbor Range of Geometric Mean (Organisms/100ml)	Detroit Range of Geometric Mean (Organisms/100ml)	Ann Arbor Geometric Mean of all Storms (Organisms/100ml)	Detroit Geometric Mean of all Storms (Organisms/100ml)	Ratio of Combined (Detroit) To separate (Ann Arbor) Overflows
April-May	Tot.Col.	116,000- 880,000	575,000-23,600,000	279,000	3,350,000	14:1
	Fec.Col.	7,400- 73,000	187,000- 3,570,000	19,300	1,040,000	54:1
	Fec.Strep.	12,000- 323,000	276,000- 1,490,000	44,900	510,000	12:1
June-July	Tot.Col.	187,000-15,000,000	1,340,000-45,000,000	2,670,000	20,100,000	8:1
	Fec.Col.	24,100- 560,000	470,000-10,500,000	105,000	3,230,000	31:1
	Fec.Strep.	42,500- 670,000	185,000- 980,000	201,000	453,000	2:1
Aug-Sept	Tot.Col.	220,000-34,300,000	3,200,000-45,000,000	2,550,000	17,200,000	7:1
	Fec.Col.	165,000- 747,000	500,000-16,500,000	395,000	5,810,000	15:1
	Fec.Strep.	120,000- 362,000	410,000- 790,000	270,000	545,000	2:1
Oct-Nov	Tot.Col.	-	900,000-18,200,000	-	1,280,000	-
	Fec.Col.	-	900,000-17,400,000	-	1,250,000	-
	Fec.Strep.	-	-	-	-	-

13. Overflow from the combined sewers occurred 3-4% of the time during the survey period. Rate of discharge per hour from the combined sewers varies with the intensity of the storm, making an exact ratio of sewage from the Conners gravity system to the discharge to the Detroit River impossible. Within the limits observed during the study, 50-80% of the raw sewage collected is spilled over into the River during the overflow. Thus approximately 2% of the total raw sewage contributed to the Detroit area plants reaches the Detroit River each year. This is over 5 billion gallons of raw sewage flowing into the River each year. Furthermore, this is a conservative estimate, since the Connor system is designed for more storage capacity than many other combined sewers in the Detroit and downriver collection systems.

Effect of Overflows from Combined Sewers on Detroit River

Several times special field investigations were made to determine the effect of overflows from combined sewers upon the Detroit River during or following rainfall. This was accomplished by collecting bacteriological samples above and below combined sewer outfalls during and following fainfall and comparing results from these analyses with dry weather data. Nine storms during which overflows occurred, in the period April 23, 1963, through August 15, 1964, were studied. Total coliform, fecal coliform, and fecal streptococcus determinations were made on samples collected during this period. Five ranges from the head to the mouth of the Detroit River were selected for this special sampling program to minimize the impact on the laboratory and get the most significant results with minimum effort.

Figure 48-V depicts the change in bacteriological densities during July 1963, following three storms of sufficient magnitude to cause overflow from combined sewers. Figure 49-V shows the increase in total coliform densities from the headwaters to the mouth during a typical overflow. The value at the station nearest the United States shore is shown in Figures 48-V and 49-V. These Figures, together with Project and municipal data, support the following conclusions:

1. Coliform, fecal coliform, and fecal streptococcus densities increased in the Detroit River, following an overflow from combined sewers, 10 to 50 times over the values found during dry weather conditions.

2. Coliform densities in the Detroit River following an overflow often exceeded 300,000 per 100 ml and at times exceeded 700,000 per 100 ml.

3. All high bacteriological values in the Detroit River during or following an overflow were found below Conners Creek. Bacteriological densities above this point stayed fairly constant during wet and dry conditions. Conners Creek represents the most upstream location of many combined sewer outfalls which extend to the mouth of the River.

4. Analysis of the City of Detroit sampling records reveals individual analyses exceeding 800,000 coliforms per 100 ml in the Detroit River on the day following significant rainfall.

5. High bacteriological densities following overflows were found at both the City of Wyandotte water intake and the new City of Detroit intake near Fighting Island. The Wyandotte values exceeded 100,000 per 100 ml and the Fighting Island values 10,000 per 100 ml.

6. The effect of overflows on water quality in the Detroit River has been observed as long as 4 days after the rain subsided.

7. Each of the nine storms individually investigated produced a severe effect on water quality in the Detroit River as evidenced by increased bacterial contamination. This effect was also noticed in statistical evaluation of regular data by wet or dry conditions.

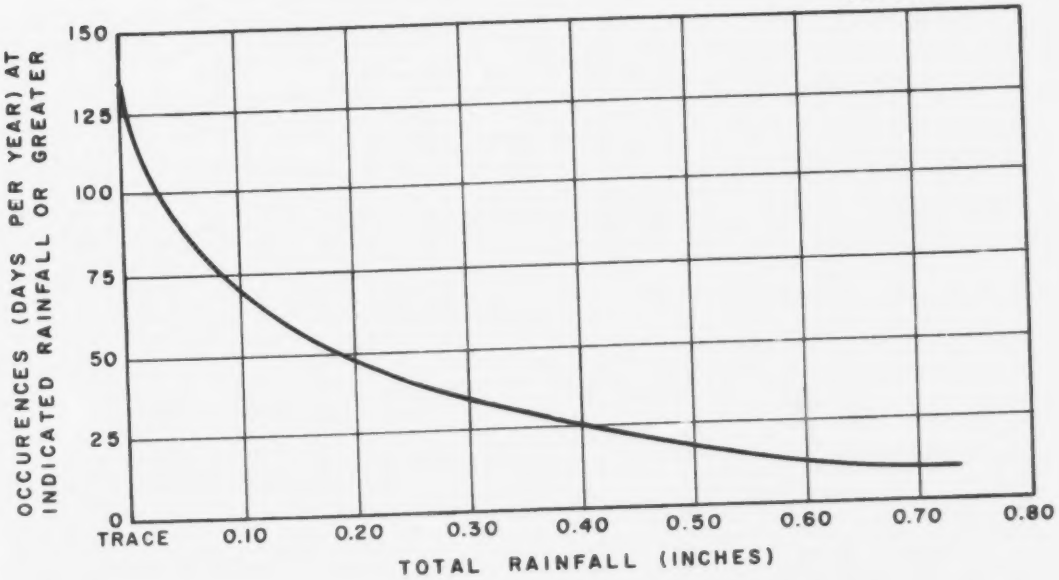
8. The length of the effect of overflows of combined sewers upon water quality in the Detroit River varies from 1 to 4 days after the beginning of the actual discharge.

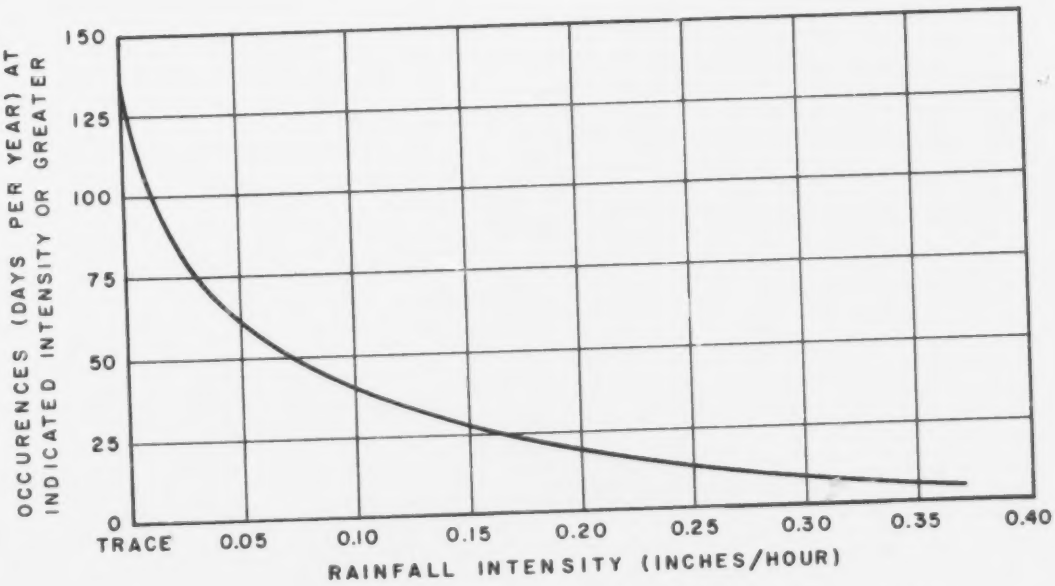
9. The greater the rain the longer the period of overflow and more severe the effect on the Detroit River.

10. While bacteriological analysis was used to compare normal conditions with those found during or following an overflow, other observations were made by field personnel in the area during heavy rains which indicated the deleterious effect of the overflows upon water quality in the River. Field notes on these occasions described debris and garbage as well as excrement floating down the Detroit River.

11. Analysis of rainfall, overflow, and stream quality records reveals that during a 9-month period in 1963 (March - November) overflows from combined sewers affected water quality in the Detroit River during part or all of 88 days. This represents 32 per cent of the days in the 9-month period. This phenomenon occurred during the year of lowest accumulated rainfall and could represent an even greater effect on Detroit River water quality during a year of normal rainfall.

FIGURE 47-V





BASED ON 20 YEAR RECORDS AT DETROIT CITY AIRPORT

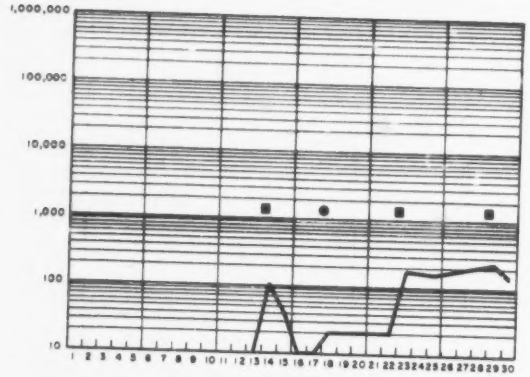
DETROIT RIVER - LAKE ERIE PROJECT

EXPECTED FREQUENCY OF RAINFALL
CITY OF DETROIT

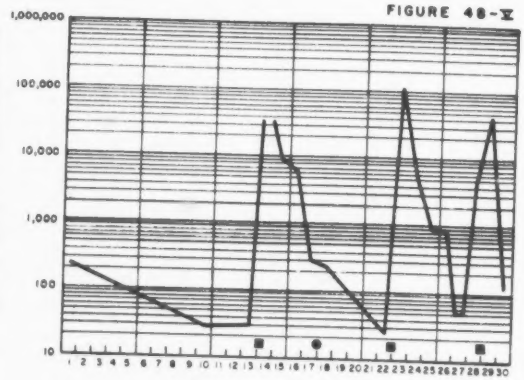
U.S. DEPARTMENT OF HEALTH, EDUCATION, & WELFARE
PUBLIC HEALTH SERVICE
REGION V GROSSE ILE, MICHIGAN

770-026 O-65-14

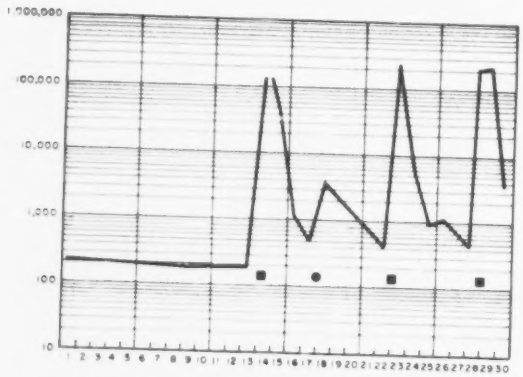
FIGURE 48-V



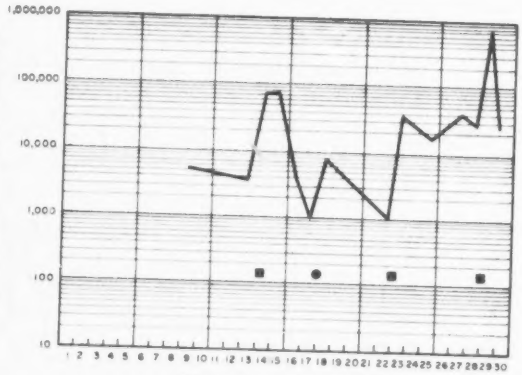
DT 30.8W—100 FEET



DT 28.4W—100 FEET



DT 20.6—50 FEET



DT 14.6W—100 FEET

RAINFALL ACCUMULATIONS (Detroit City Airport)

July 14 —— 0.67 Inches
July 17 —— 0.16 Inches
July 22 —— 1.33 Inches
July 28,29— 0.52 Inches

OVERFLOW DURATIONS

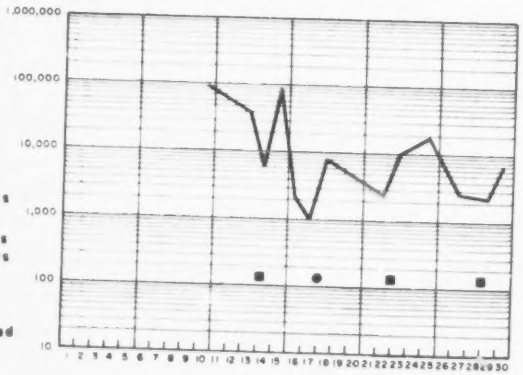
July 14 Leib-Jefferson-6 Hours, Conners Creek-12 Hours
July 17 Leib-Jefferson-4 Hours; Conners Creek-None
July 22 Leib-Jefferson-4 Hours; Conners Creek-7 Hours
July 28,29— Leib-Jefferson-3 Hours; Conners Creek-13 Hours

SCALE

Horizontal—Dates During July, 1963 as Indicated
Vertical— Log Scale Total Coliform (MF) per 100ml as Indicated

LEGEND

■ Overflow at Both Conners Creek and Leib-Jefferson
● Overflow at Leib-Jefferson Only



DT 3.9—2500 FEET

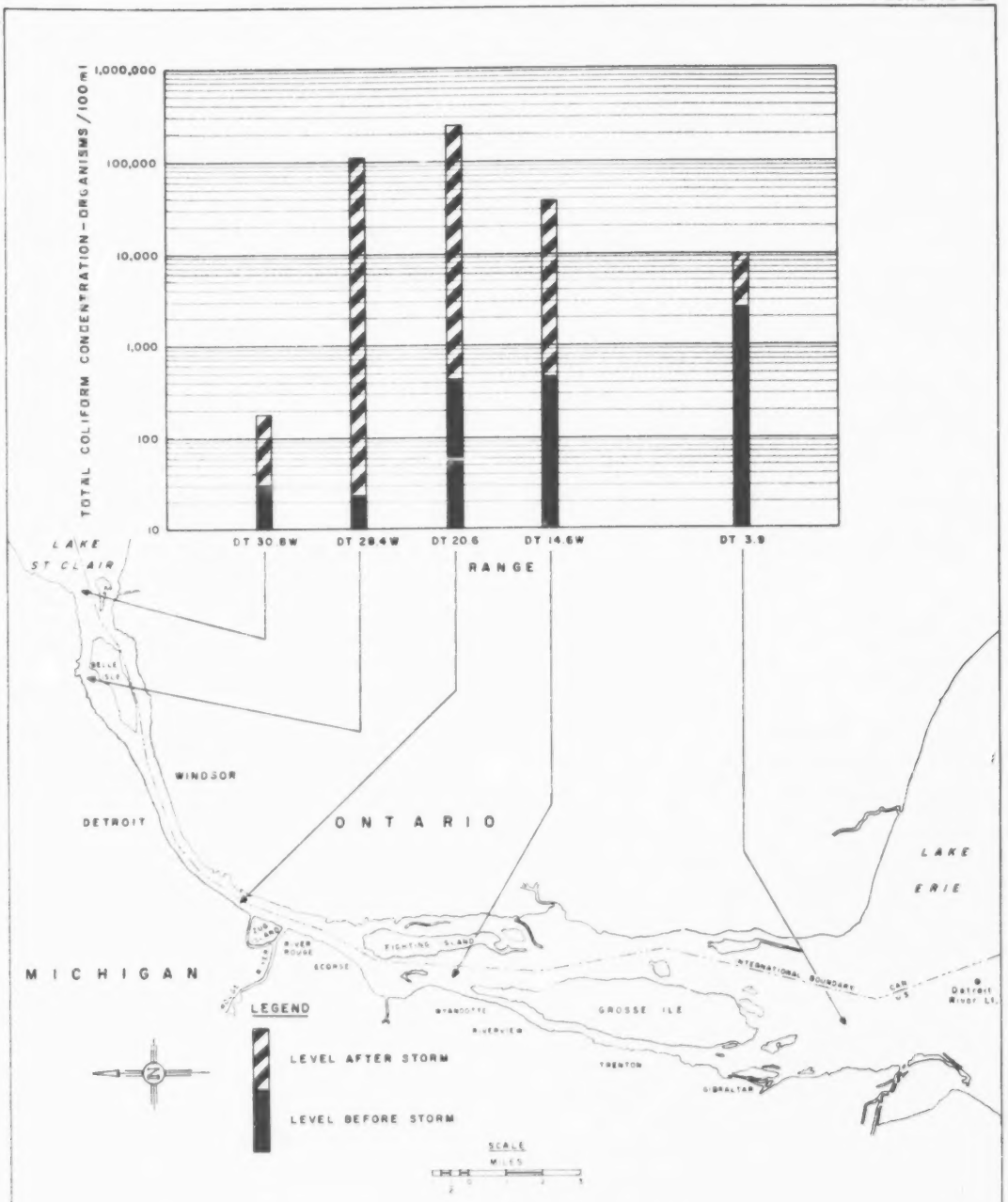
DETROIT RIVER—LAKE ERIE PROJECT

SUMMARY OF STORM EFFECTS DURING JULY 1963

STATION NEAREST U.S. SHORE
DETROIT RIVER

U.S. DEPARTMENT OF HEALTH, EDUCATION, & WELFARE
PUBLIC HEALTH SERVICE
REGION V GROSSE ILE, MICHIGAN

FIGURE 49-V



DETROIT RIVER-LAKE ERIE PROJECT

TOTAL COLIFORM CONCENTRATIONS
BEFORE & AFTER STORM OF JULY 22, 1963

STATION NEAREST U.S. SHORE
DETROIT RIVER

U S DEPARTMENT OF HEALTH, EDUCATION, & WELFARE
PUBLIC HEALTH SERVICE
REGION V GROSSE ILE, MICHIGAN

Grosse Ile Pollution Survey

Several studies were made in waters adjacent to Grosse Ile to determine the effect of local waste sources on the quality of water of beach and residential areas at the southerly end of Grosse Ile. In addition to chemical and bacteriological analyses, limited tracer studies were made to determine the flow patterns for the given conditions of test. Information collected during this study is presented in Figure 21-V and Table 18-V.

A study was made on the east side of Grosse Ile in the area between Stony Island and Grosse Ile, extending to Hickory Island and Sugar Island. On 3 days, samples were collected at the points indicated on Figure 21-V and on the western half of Range 9.3E. A tracer study was made by placing dye at the midpoint between Stony Island and Grosse Ile in line with the abandoned bridge connecting the Island and at a location adjacent to the shore at the extension of Bellevue Road. The results of the 3-day study are summarized in Table 18-V.

At the time the tracer study was made, the rising water level likely had an influence on the flow pattern noted. As observed by the dye tracings, the current was retarded in part as a result of the rising water level. This is indicated by the shifting of the dye to a position below Stony Island rather than proceeding directly down the thread of the stream; however, one would expect some movement in this direction as a result of the changing flow and cross-sectional area. The dye placed near the septic tank outfall at the end of Bellevue Road moved along the shoreline in the shallow waters, and its apparent movement was retarded by the heavy weed growth in those areas.

Other tests of the flow pattern in this area have indicated that some of the flow from the Livingstone Channel passes below Power House Island and proceeds to discharge into Lake Erie between Hickory and Sugar Islands. Dye introduced above Power House Island indicated that the flow proceeded in the direction between Hickory and Sugar Island.

During the limited period of study, the coliform count on the beach adjacent to Sugar Island indicated that water quality was unsafe for swimming. In two of the three instances, the coliform count was higher at the midpoint between Sugar and Hickory Islands than on the beach. Coliform counts below Elba Island were generally higher than coliform counts found in the thread of the stream, indicating that the residential areas adjacent to and above Elba Island contribute to impairing water quality. The water of the samples taken in the thread of the stream bed did not meet acceptable standards for swimming. Major improvement in waste water treatment for residential areas on Grosse Ile would improve the water along some of the residential shoreline, but may not improve the quality of water adjacent to beach areas to an acceptable level. The water quality on Sugar Island can be improved if the water upstream in the Detroit River is improved, as well as various local sources of pollution.

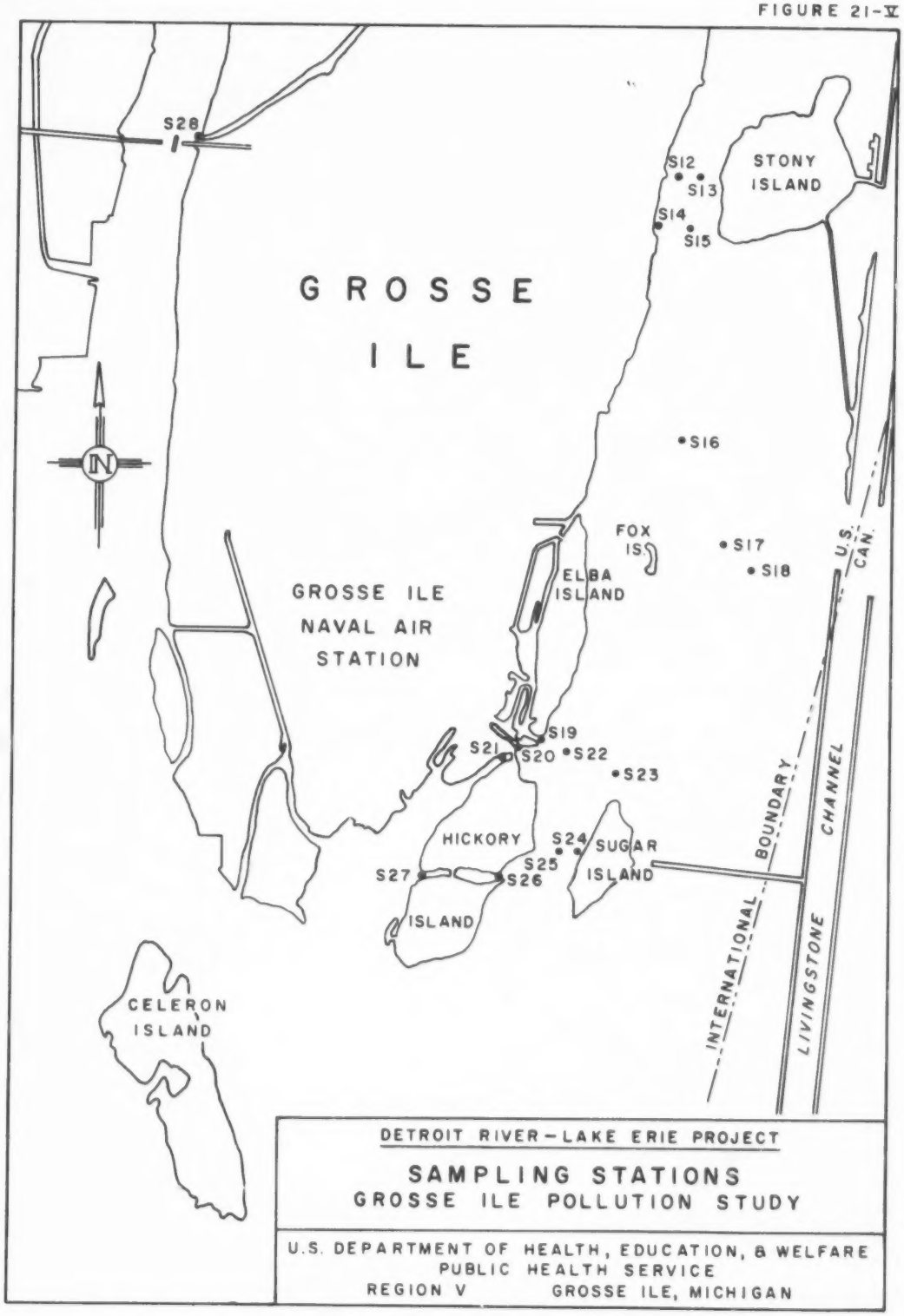
The continuing effort of the State of Michigan regulatory agencies to bring about pollution abatement and reduce the threat to the public health caused by this condition is recognized. This Project is also aware of the plan to install sewers and a primary sewage treatment plant on the island.

TABLE 18-V. SUMMARY OF RESULTS OF GROSSE ILE POLLUTION STUDY

(Note: See Figure 20-V for location of sampling stations.)

Location	Range of Observed Values				
	Temp °C	Chlorides mg/l	Total Coliform Org/100 ml	Fecal Coliform Org/100 ml	Fecal Strep. Org/100 ml
DT 9.3E - 100'	18.0-20.0	16-20	1,900-3,200	95-160	10-20
DT 9.3E - 200'	18.5-20.0	7-17	700-5,000	60-105	10-20
DT 9.3E - 500'	19.0-20.0	14-20	800-2,200	72-440	10-20
DT 9.3E - 1200'	19.0-20.0	8-22	2,800-22,000	280-6,150	10-30
No. 12	18.5-20.0	19-25	3,000-26,000	40-155	20-30
No. 13	18.5-20.0	12-27	2,000-4,000	400-600	10-60
No. 14	18.0-19.5	10-27	1,000-8,000	50-1,200	50-300
No. 15	19.0-20.0	9-22	2,700-22,000	405-12,100	<10
No. 16	19.0	15-24	3,600-25,000	180-7,500	20-60
No. 17	19.0-20.0	9-27	9,000-11,000	405-2,200	5-30
No. 18	19.0-20.0	11-16	3,900-5,000	<70-1,500	10-15
No. 19	18.0-2[illegible]0	16-31	4,100-16,000	205-2,400	70-120
No. 20	18.0-2[illegible]0	14-26	1,800-6,300	270-315	90-180
No. 21	17.5-20.0	17-25	3,600-8,600	430-540	60-170
No. 22	19.0-20.0	9-17	2,400-19,000	300-9,500	30-60
No. 23	18.5-19.5	7-17	1,400-10,000	140-4,000	10-80
No. 24	18.0-20.0	8-18	1,200-4,000	20-3,600	10-25
No. 25	18.5-20	15-19	<1,000-12,000	570-6,000	30-120
No. 26	18.5-20.0	16-25	1,400-5,600	350-1,120	20-60
No. 27	18.5-20.00	17-26	900-2,400	120-270	70-120
Thorofare Canal on West River Road	17.5-21.0	8-27	21,000-24,000	1,100-9,600	130-2,700

FIGURE 21-V


S28
S12
S13
S14
S15
STONY ISLAND
GROSSE ILE
N
S16
FOX IS
S17
S18
U.S. CAN.
ELBA ISLAND
GROSSE ILE NAVAL AIR STATION
S19
S21
S20
S22
S23
HICKORY
S24
SUGAR ISLAND
S25
S27
S26
ISLAND
INTERNATIONAL BOUNDARY
LIVINGSTONE CHANNEL
CELERON ISLAND
DETROIT RIVER—LAKE ERIE PROJECT
SAMPLING STATIONS
GROSSE ILE POLLUTION STUDY
U.S. DEPARTMENT OF HEALTH, EDUCATION, & WELFARE
PUBLIC HEALTH SERVICE
REGION V
GROSSE ILE, MICHIGAN

Investigation of Bacteriological Regrowth

Review of the literature regarding coliform bacteria results in streams brought attention to the matter of bacterial regrowth and die-off. Some rivers seemed to exhibit a marked increase in total coliform bacteria within a few hours after discharge occurred to the stream, while other rivers did not have this characteristic. In order to evaluate adequately the coliform bacteria results of the Detroit River-Lake Erie Project, it was therefore necessary to determine the pattern of bacterial regrowth and die-off in the Detroit River.

The purpose of this survey was threefold: First, to pinpoint and define sources of bacterial contamination going into the Detroit River; second, to determine channeling of wastes in the River; and third, to calculate the pattern of regrowth and die-off of coliform bacteria in the Detroit River. In view of the fact that the City of Detroit chlorinates its waste effluent to protect downstream sources of water supply, it became especially important to evaluate this third factor, since experiences elsewhere have shown that there is a significant increase in coliform organisms when chlorinated sewage is diluted with river water.

The survey was conducted August 12 through August 15, 1963, from a point 300 feet above the Detroit Sewage Treatment Plant outfall to Point Hennepin at the north end of Grosse Ile. The results were as follows:

1. No significant regrowth or die-off of coliform bacteria occurs in the Detroit River from the Rouge River to Point Hennepin.

2. The first day's sampling indicated a regrowth immediately below the Rouge River; however, during the remainder of the study a slight die-off occurred.

3. Bacterial pollution discharged at the Rouge River and the Detroit Sewage Treatment Plant remained in American waters as far downstream as Point Hennepin.

4. Approximately 62 per cent of the bacterial pollution discharged at the Rouge River and the Detroit Sewage Treatment Plant followed the channels closest to the American shore. The remaining 38 per cent was distributed in other channels east of Grosse Ile.

City of Detroit Raw Sewage Bypass

In May 1963, the City of Detroit submitted a request to the Michigan Water Resources Commission for a temporary increase in use of the waters of the Detroit River. This temporary use arose from the need to replace badly worn 40-year-old sluice gates at the Fairview Pumping Station, requiring the bypassing of raw sewage to the Detroit River for approximately 10 days in December. The Commission ruled that the City of Detroit could proceed with planning for the proposed bypass and that, upon the recommendation of the Michigan Department of Conservation's waterfowl specialist, the bypass be restricted to a 10-day consecutive period between the dates November 10 to November 30. The Commission also decided that all affected parties should be notified by the City of Detroit just before the operation would begin. Accordingly, the Michigan Department of Health issued a permit to the City for the temporary bypassing of untreated sewage.

Consequently, the City of Detroit began operations to replace the sluice gates by turning off the pumps at the pumping station at 0800, Tuesday, November 12. The field crews of the Project began to measure the effect of the untreated sewage on the water quality of the Detroit River by sampling night and day beginning 0100 Tuesday morning. Sampling activities continued through the weekend and into the next week until the sluice gates had been replaced and operations returned to normal. The City completed the construction work and the station was placed back in service at 0810, Friday, November 22. Operations went according to regulations specified by the Michigan Department of Health in their permit to the City. Project sampling activities to measure the effect of the bypass continued until the effect had diminished.

During the operation the precise amount of sewage being bypassed to the River was not known since the City was apparently able to route an estimated 50 mgd around the Fairview Pumping Station. It is probable that 75 mgd was discharged directly to the River. Although it was assumed that the bypassing operation would occur constantly throughout the day and night, this was not the case. Erratic discharge of this material especially at night and during the early morning hours required a revision of the Project sampling schedule to take this into account.

Project files contain detailed accounts of the results of the sampling during this 10-day period. The first effects of the bypassing on water quality in the receiving stream were detected at 3 a.m. on the second day, approximately 9 hours after the initial discharge of bypassed sewage.

In summary, bacteriological results at the head of the Detroit River indicated very low densities (less than 100 organisms per 100 ml) throughout the entire operation, indicating that this range was not affected by the operation. In the upper part of the River significant rises in coliform and fecal streptococcus organisms were noted, especially near the United States shore. The effects of pollution were noted in a band along the shore, which increased in width from 300 feet just below Conners Creek at Range DT 28.4 to about 500 feet 8 miles downstream at a point just above the Rouge River. Coliform counts in this area increased from 10 to 100 times normal dry weather values with counts observed in the range of 10,000 to 100,000 organisms per 100 ml.

Below the Rouge a similar increase in coliform density over normal dry weather condition was noted, with the width of the polluted water increasing to approximately 1,000 feet. On the Canadian side of Fighting Island no increase in bacterial densities was observed, and the data indicate the bypassing had no effect on water quality in this area.

Further downstream at Range DT 14.6 an increase was noted in coliform and fecal streptococcus densities on the second day of the bypass in a band about 3,000 feet in width. Results in the Trenton Channel indicated dispersal of increased coliform densities

AREA LOCATION MAP
MICHIGAN
LAKE ST CLAIR
DETROIT
WINDSOR
ONTARIO
LAKE ERIE
TOLEDO
MICHIGAN
DETROIT
WINDSOR
LAKE ST CLAIR
BELLE ISLE
RIVER ROUGE
ECORSE
ONTARIO
LEGEND
AREA AFFECTED

209a

20

DET

AREA AF
RA

U S DEPART

RE

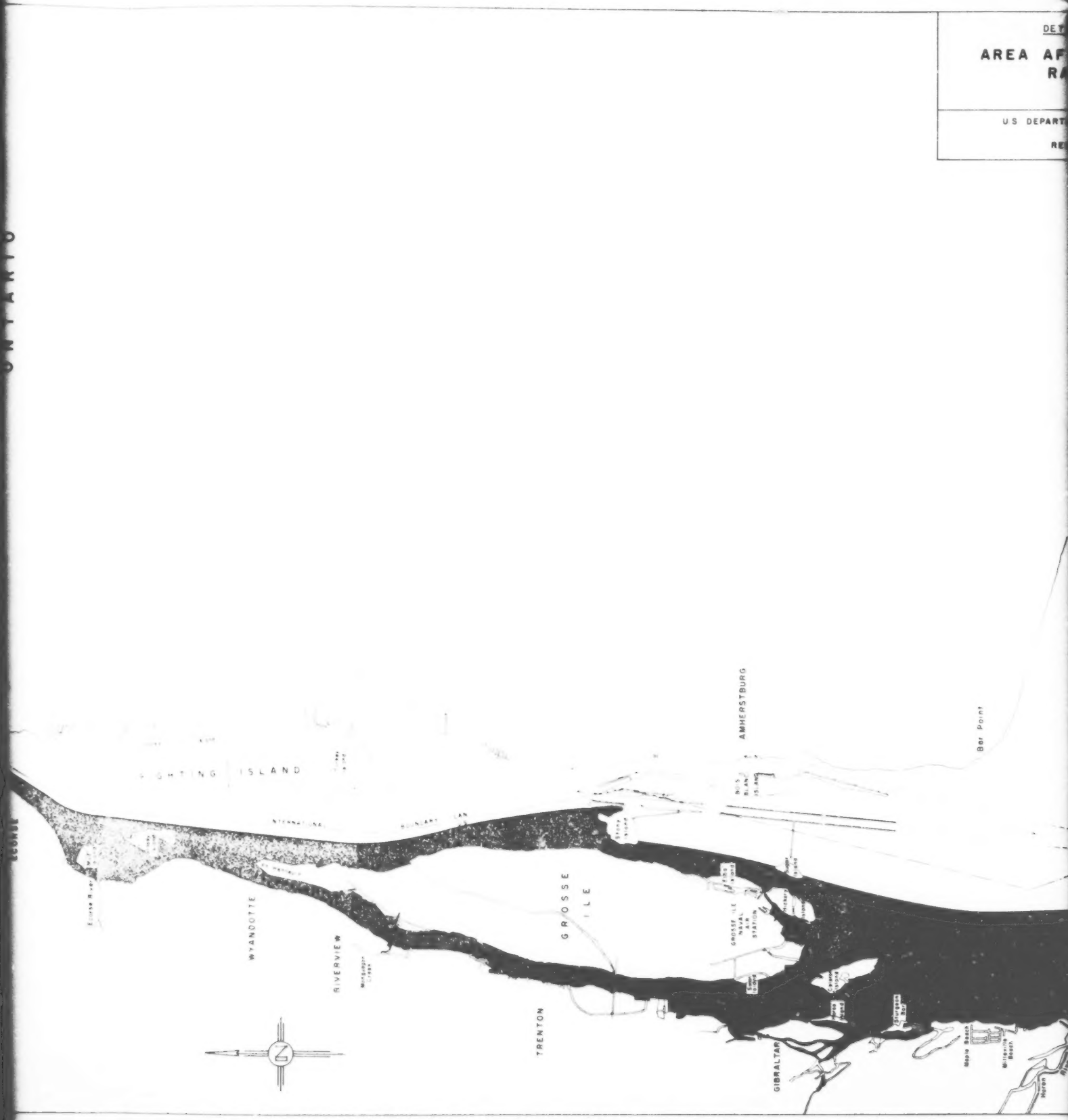


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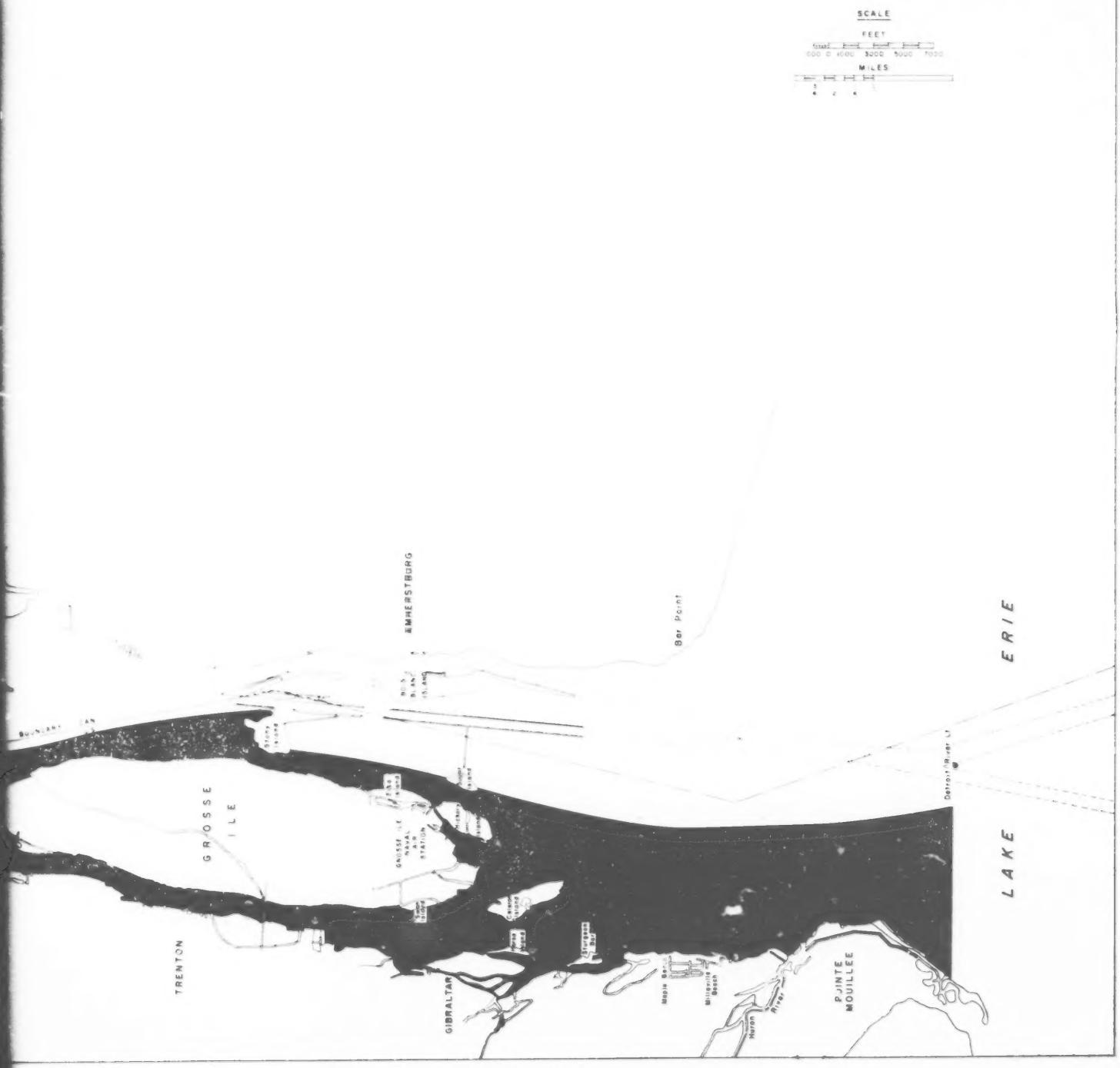
FIGURE 22-V

DETROIT RIVER–LAKE ERIE PROJECT

AREA AFFECTED BY CONNERS CREEK RAW SEWAGE BYPASS

DETROIT RIVER

U.S. DEPARTMENT OF HEALTH, EDUCATION, AND WELFARE
PUBLIC HEALTH SERVICE
REGION V GROSSE ILE, MICHIGAN



209C

throughout the entire channel, while results at the mouth of the Detroit River showed a 7,000 foot band of increased coliform density (10,000-30,000 organisms per 100 ml) near the United States shore.

The Rouge River and Conners Creek were also monitored and geometric mean values of 10,500,000 per 100 ml observed at Conners Creek and 52,000 per 100 ml at the Rouge.

An effort was made to determine the effect of the bypassing on the beaches of Lake Erie. Beaches from the mouth of the Detroit River to below the Raisin River were sampled. Although high coliform densities were observed at several of the beaches, the only beach which definitely showed the effect of the bypass was Maple Beach, located near the mouth of the Detroit River, while Dewey Beach possibly showed a slight effect of the operation.

Figure 22-V depicts the area in the Detroit River affected by this bypassing operation. Table 19-V summarizes pertinent results of the sampling conducted during this survey.

TABLE 19-V. SUMMARY OF AVERAGE RESULTS OF

CITY OF DETROIT RAW SEWAGE BYPASS

NOVEMBER 12-22, 1963

Range	Feet	Total Coliform Avg./100 ml	% Fecal Coliform	Fecal Streptococci Avg./100 ml	Typical Coliform Value Before Bypass	Typical Coliform Value After Bypass
DT 30.8W	100'	10	20	2	20	20
	300'	11	18	5	30	6
	500'	15	7	5	20	14
	1,000'	19	52	5	30	30
	2,500'	10	29	5	6	15
DT 28.4W	100'	25,000	41	200	10	410,000
	300'	2,800	48	27	20	59,000
	700'	59	20	3	70	100
	1,300'	61	28	2	30	330
DT 26.8W	52'	380,000	36	540	270	510,000
	169'	340,000	38	460	240	390,000
DT 20.6	5'	79,000	40	360	110	180,000
	50'	17,000	48	71	90	250,000
	200'	57,000	33	330	50	140,000
	400'	10,000	35	39	50	710,000
	600'	1,100	35	58	28	5,100
	700'	440	38	11	44	2,400
	1,000'	80	37	6	12	370
	1,500'*	200	57	4	360	300
	1,800'*	470	40	8	2,900	310
	2,000'*	3,100	45	86	10,000	2,000
	2,300'*	8,400	60	21	34,000	6,200
DT 17.4W	100'	12,000	35	30	1,200	80,000
	200'	13,000	63	23	100	41,000
	400'	17,000	37	310	100	150,000
	800'	9,400	40	56	100	36,000
	1,200'	1,000	37	13	20	1,300
	1,600'	130	40	2	20	200
	2,200'*	100	28	3	80	100

* Canadian Stations

TABLE 19-V - Continued.

Range	Feet	Total Coliform Avg./100 ml	% Fecal Coliform	Fecal Strepcococci Avg./100 ml	Typical Coliform Value Before Bypass	Typical Coliform Value After Bypass
DT 14.6W	20'	15,000	47	66	700	27,000
	100'	22,000	40	120	900	17,000
	200'	18,000	50	79	300	180,000
	300'	17,000	73	120	500	63,000
	400'	31,000	39	180	700	220,000
	800'	15,000	43	140	2,500	34,000
	1,000'	28,000	40	190	900	33,000
	2,000'	1,800	80	22	600	11,000
	3,000'	2,700	44	5	1,300	7,000
DT 8.7W	80'	6,400	24	5	2,700	21,000
	280'	9,100	34	9	3,500	22,000
	480'	21,000	37	60	4,900	270,000
	680'	18,000	52	93	5,400	320,000
	980'	23,000	42	66	5,500	290,000
	1,240'	17,000	36	120	4,300	310,000
DT 3.9	2,500'	27,000	35	10	23,000	57,000
	3,500'	24,000	33	6	7,700	89,000
	4,500'	19,000	27	230	2,500	210,000
	5,500'	12,000	37	53	600	170,000
	6,500'	22,000	33	190	2,200	99,000
	7,500'	8,400	55	55	1,500	67,000
	9,500'	4,700	41	39	400	35,000
	11,500'*	2,600	42	22	1,100	8,700
	13,500'*	1,700	51	54	600	7,600
	15,000'*	1,000	46	24	460	2,300
	16,500'*	850	53	34	2,300	1,800
	17,500'*	2,500	56	30	8,400	1,100
	18,500'*	5,700	50	160	9,900	12,000
	19,000'*	8,200	40	160	7,700	23,000
	19,300'*	9,700	49	160	9,900	24,000

* Canadian Stations

Alternate Bypass of Treated Sewage

The City of Detroit requested permission to shut down the Detroit River outfall and bypass treated effluent into the Rouge River in order to allow inspection and renovation of the regular outfall. Permission was granted by State agencies with the provision that an experimental testing period be undertaken to determine any deleterious effect this action might have upon the receiving waters and the users thereof. The scheduled commencement date of this experimental period was July 27, 1964.

After learning of this proposed action through minutes of meetings of the Michigan Water Resources Commission, a brief surveillance of the action was planned by personnel of this Project. On July 23 regular sampling operations revealed extremely high total and fecal coliform densities in the Rouge River and in the lower part of the Detroit River during dry weather. This was especially pronounced at station DT 14.6, where coliform densities of over 200,000 organisms were found at all stations and a count of 620,000 organisms per 100 ml was found near the Wyandotte water intake. A total coliform density of 3,700 organisms per 100 ml was found at the new City of Detroit water intake near Fighting Island. Results in the Rouge River near its mouth exceeded 2 million total coliform organisms per 100 ml. Fecal coliform densities were similarly high, exceeding 200,000 organisms in the Rouge and over 50,000 in the Detroit River, at station DT 14.6 near Wyandotte. Fecal streptococcus densities in the Rouge and Detroit Rivers were low on this date with all but one result below 1,000 organisms per 100 ml. (The exception was 1,950 on the Rouge.)

The Michigan Water Resources Commission and the Michigan Department of Health were notified on July 24 when the results were read in the Project laboratory. The City of Wyandotte, a downstream user of water, was also notified on this date. Investigation of the alternate bypass on the Rouge River revealed on July 23 and 26 that the discharge through this outfall had already begun.

Project sampling continued over the weekend and similar results obtained. Telephone calls were received from the Michigan Department of Health and the Michigan Water Resources Commission with information that the City of Detroit was notified of the Project's concern and had instigated sampling over the weekend. The results of their sampling caused them to suspend bypassing operations Monday morning.

On Thursday, July 30, the waters were sampled, and coliform densities dropped to normal dry weather levels. During the period of actual partial bypass (July 19-27) two rains occurred--July 20 and July 25. The first was very light, and any effect should have been dissipated within 24 hours. The second could have affected water quality on July 25 and possibly July 26 but certainly not on July 23 and 24, when the City of Detroit sampled.

Checking with the City of Wyandotte revealed consistently high coliform densities during the period July 19-27, 1964, with results exceeding 110,000 organisms per 100 ml. The results at the intake during the 3 days following the cancellation of the bypass indicated a sharp reduction to less than 1,000 organisms per 100 ml.

It is interesting to note that the highest individual coliform value at station DT 14.6 near Wyandotte (620,000 per 100 ml) was recorded during this bypass in a period of dry weather. Values at the station in the Detroit River immediately above the Rouge River remained low during and after this period except for samples collected on August 3, following a heavy rain.

Evaluation of this experience emphasizes the necessity for careful study of the effects of bypassing on water quality and the desirability for designing sewage treatment facilities to properly cope with this situation.

Bottom Deposits

Analysis of bottom materials to determine the effects or extent of water pollution is a field in which there is little basis for quantitative interpretation. "Standard Methods" gives only passing mention of recommended procedures for field and laboratory, and considerable difficulty is involved in working with a solid-liquid mixture rather than a liquid. For these reasons, bottom deposits were treated only in a general way, to show differences in bottom composition in various areas of the Lake.

Time is also a factor with bottom materials. They may remain undisturbed underwater year after year, long after the original waste source has ceased to exist. Therefore, the current bottom condition cannot be conclusively identified with existing effluents. It can be definitely stated, however, that the condition of the bottom is caused by the settling of waste materials, and if suspended solids continue to enter the river they will settle in the same areas as before and cause the same problems.

A sampling technique was developed to enable a boat crew to collect the samples while drifting over the area. A special drag-type sampler was used to scoop up the top 0.2 to 0.3 feet of material. The results are qualitative for each site, and no attempt was made to determine thickness of settled deposits.

Only one sample was taken at each location, and the locations were widely spaced to cover a variety of conditions in each area. By grouping the results by area, certain trends were noted. These areas were selected according to the bottom material quality shown by observations and chemical analysis. Each area was then rated as good, fair, or poor, according to the overall indications for that area.

Good condition: Natural bottom conditions of sand, gravel, mud or silt without oil, grease or odor, and without abnormally large amounts of waste-associated materials.

Fair condition: Natural bottom condition with some evidence of deposited material, slight oil or odor, and moderate amounts of waste-associated materials.

Poor condition: Bottom deposits or organic or other material having oily appearance and odor of oil or sewage; large amounts of waste-associated materials, such as greases, phenols, total nitrogen, phosphates, and iron; high percentages of volatile materials and a pH higher or lower than surrounding areas.

Solids settled over the natural bottom disrupt or eliminate fish and other aquatic life. In shallow water, they are offensive to swimmers and boaters, and when fluctuating water levels expose beds of these materials, the resulting appearance and odors destroy the aesthetic value of the waterways.

Since most of the bottom material in the poor condition areas is light and easily disturbed, there is a constant problem when this material is resuspended in the water during stormy weather or from the passage of large boats. Resuspended bottom materials in the poor condition areas increase turbidity, oxygen demand, algae growth, and taste and odor problems, which decrease the quality of the water for riverside or lakeside recreation, fishing, swimming, water skiing, and industrial and municipal water supply. This increased turbidity is frequently observed in the Detroit River and Lake Erie during stormy weather.

Figure 23-V shows the Detroit River classified according to the type of material deposited on its bottom. Tables 20-V through 25-V summarize the results of the bottom deposit studies of the Rouge River and separate areas of the Detroit River. In addition to the indices shown on these tables, analyses of the bottom deposit supernatant were made for phenol, phosphate, nitrate, and ammonia concentrations. All of these factors, including field observations, were taken into consideration in characterizing bottom conditions.

From the head of the Detroit River to mile point 25 at the south end of Belle Isle, the bottom was in good condition on the Canadian side and fair to good on the American. One sampling point rated poor was just below Conners Creek.

From Belle Isle to the Rouge River conditions on both sides of the Detroit River were fair with better bottom in midriver. An area rated poor began just above Zug Island and extended southward along the United States shore.

All stations sampled on the Rouge River indicated poor condition.

Below the Rouge River to mile point 15 at the head of Grosse Ile, all points along the United States shore were poor. Those in faster moving water were somewhat better.

From mile point 15 to the Grosse Ile County Bridge, the bottom condition of the Trenton Channel (west of Grosse Ile) was poor. East of Grosse Ile, the bottom condition in United States waters was fair, and generally fair to good in Canadian waters.

From the County Bridge to the mouth of the Detroit River, the bottom condition was poor in the Trenton Channel and below Grosse Ile poor along the United States shore. The waters were generally fair on the east side of Grosse Ile.

Organic material in a state of decomposition, having a dark color, oil or sewage odor, and oily appearance, was found in isolated places in the Detroit River above Zug Island. These occurrences could be attributed to storm water overflows or other organic deposits.

Around Zug Island and the Rouge River, bottom material was in very poor condition, and this situation prevailed along the United States shore to Ecorse and throughout the Trenton Channel to Lake Erie. Bottom materials on the Canadian side of the river and east side of Grosse Ile were in fair to good condition.

Samples taken of the mud-water interface in the turning basin at the Ford Motor Company plant and in the Ford slip revealed high concentrations (500 mg/l) of both oil and iron.

TABLE 20-V. SUMMARY OF BOTTOM MATERIALS - DETROIT RIVER

MILE 30.8 TO MILE 25

	No. of Samples	Max.	Min.	Med.	Mean	Remarks
pH						
AM	13	7.7	7.1	7.4	7.4	
CAN	5	8.0	7.2	7.3	7.4	
% IRON						Low values.
AM	13	6.89	0.01	1.26	1.52	
CAN	5	4.13	0.007	1.02	1.32	
% OIL AND GREASE						Generally good except one high value from southern tip of Belle Isle
AM	13	2.10	0.003	0.02	0.28	
CAN	5	0.44	0.01	0.09	0.15	
% TOTAL VOLATILE SOLIDS						High values found at Peach Island Light and below Conners; all others low.
AM	11	12.2	1.6	7.1	6.6	
CAN	3	12.6	4.6	9.0	8.7	

CONCLUSION: Bottom conditions generally good except for areas downstream from Conners and the sewage treatment plant on Belle Isle.

TABLE 21-V. SUMMARY OF BOTTOM MATERIALS - DETROIT RIVER

MILE 25 TO MILE 19.5

	No. of Samples	Max.	Min.	Med.	Mean	Remarks
pH						10.1 just downstream from Allied Chemical at Zug Island.
AM	10	10.1	7.4	7.7	8.0	
CAN	4	7.8	7.4	7.6	7.6	
% IRON						Low values except for one 11% value at Zug Island.
AM	7	11.01	0.01	0.56	2.35	
CAN	4	4.13	0.02	0.28	1.17	
% OIL AND GREASE						Low to medium values.
AM	10	0.60	0.00	0.14	0.17	
CAN	4	0.50	0.02	0.18	0.22	
% TOTAL VOLATILE SOLIDS						Both high and low values found on both sides of river.
AM	8	17.0	8.2	8.2	10.2	
CAN	4	20.2	8.4	10.3	12.8	

CONCLUSION: Bottom conditions generally good except for the Zug Island area particularly below Allied Chemical outfall.

TABLE 22-V. SUMMARY OF BOTTOM MATERIALS - ROUGE RIVER

	No. of Samples	Max.	Min.	Med.	Mean	Remarks
pH	6	7.3	6.8	7.0	7.0	
% IRON	4	8.60	1.72	2.74	3.95	Fairly high
% OIL AND GREASE	6	4.20	1.00	1.75	2.18	Very high
% TOTAL VOLATILE SOLIDS	6	25.6	11.1	20.9	19.9	Very high

CONCLUSION: Bottom condition in the Rouge River is very poor.

TABLE 23-V. SUMMARY OF BOTTOM MATERIALS - DETROIT RIVER

MILE 19.5 TO MILE 15

	No. of Samples	Max.	Min.	Med.	Mean	Remarks
pH						
AM	13	8.1	7.2	8.0	7.8	
CAN	5	7.8	7.1	7.5	7.5	
% IRON						Variable, but generally high on American side and lower on Canadian side.
AM	9	11.45	0.05	1.13	3.62	
CAN	3	2.06	0.01	0.04	0.70	
% OIL AND GREASE						High downstream from Rouge on American side.
AM	13	3.20	.02	0.37	0.77	
CAN	5	0.32	0.006	0.07	0.11	
% TOTAL VOLATILE SOLIDS						
AM	11	17.3	9.9	13.0	13.5	
CAN	4	14.0	8.0	9.5	10.3	

CONCLUSION: Bottom condition is poor on the American side and fair on Canadian side.

TABLE 24-V. SUMMARY OF BOTTOM MATERIALS - DETROIT RIVER

MILE 15 TO MILE 8.7

	No. of Samples	Max.	Min.	Med.	Mean	Remarks
pH						
Trenton Channel	25	11.2	7.0	7.7	7.8	9.0 downstream from Wyandotte Chemical and 11.2 downstream from Firestone Steel Products.
East of Grosse Ile	11	8.0	7.2	7.6	7.6	
% IRON						
Trenton Channel	22	30.96	0.01	3.13	5.68	High in Trenton Channel; low on east side of Grosse Ile.
East of Grosse Ile	11	8.94	0.01	1.38	2.96	
% OIL AND GREASE						
Trenton Channel	25	2.11	0.04	0.15	0.41	High in Trenton Channel and below Firestone and Wye Street sewer; low on Canadian side.
East of Grosse Ile	11	0.38	0.03	0.09	0.11	
% TOTAL VOLATILE SOLIDS						
Trenton Channel	25	38.0	3.1	6.4	8.2	High values in Trenton Channel; low on East side of Grosse Ile.
East of Grosse Ile	11	12.9	1.1	4.0	4.9	

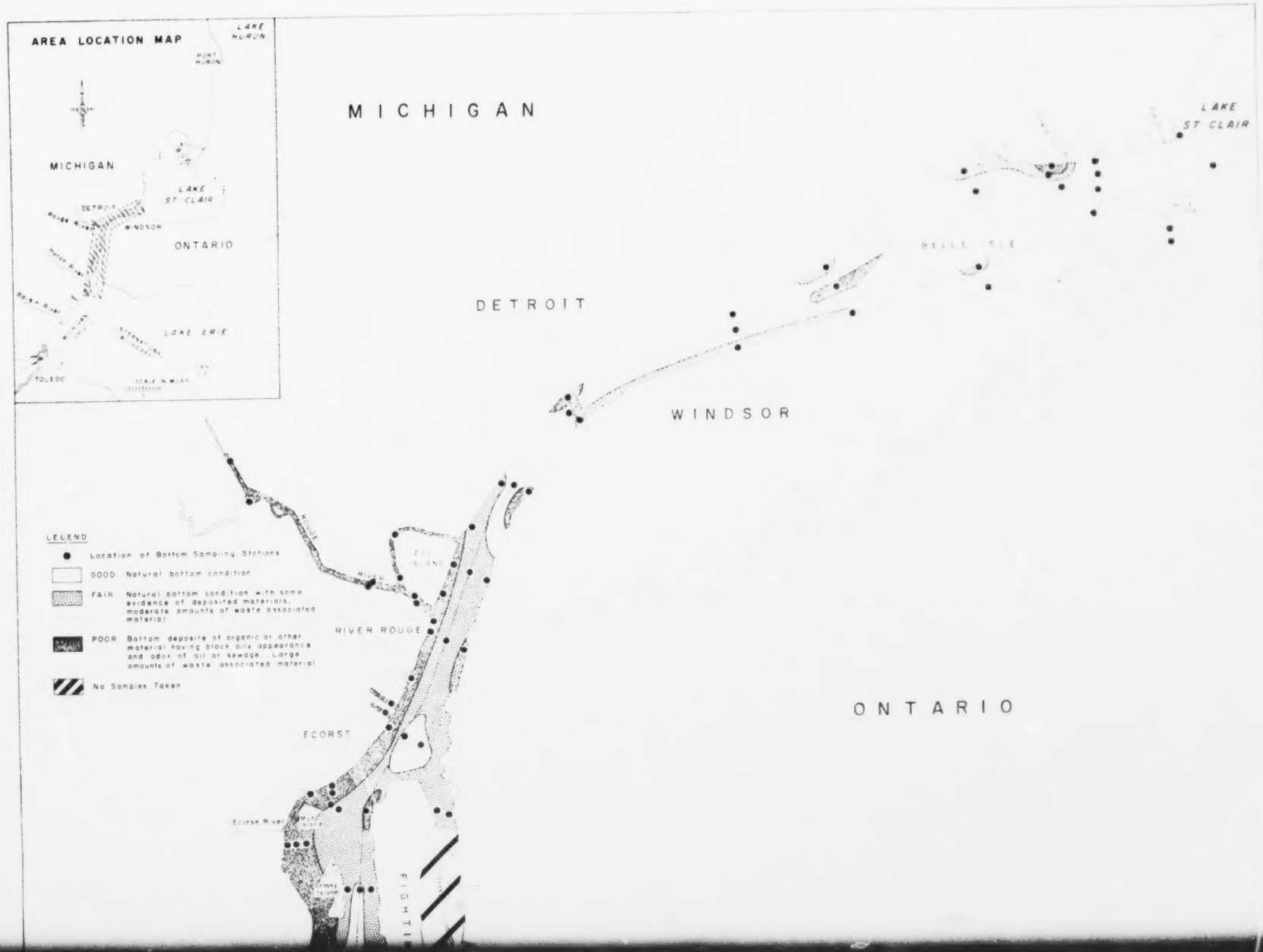
CONCLUSION: Poor bottom conditions prevail in Trenton Channel. Fair to good in waters east of Grosse Ile.

TABLE 25-V. SUMMARY OF BOTTOM MATERIALS - DETROIT RIVER

MILE 8.7 TO LAKE ERIE

	No. of Samples	Max.	Min.	Med.	Mean	Remarks
pH						
Trenton Channel	13	7.9	7.3	7.6	7.6	High values on Canadian side.
East of Grosse Ile	11	9.8	7.2	7.4	7.8	
% IRON						
Trenton Channel	12	9.63	0.004	2.83	3.26	High Trenton Channel; low on east side of Grosse Ile.
East of Grosse Ile	10	4.82	0.005	1.72	1.75	
% OIL AND GREASE						
Trenton Channel	13	2.45	0.06	0.39	0.53	Higher values in Trenton Channel.
East of Grosse Ile	10	0.64	0.02	0.21	0.26	
% TOTAL VOLATILE SOLIDS						
Trenton Channel	12	17.3	2.1	7.8	8.0	High in Trenton Channel; low on east side of Grosse Ile.
East of Grosse Ile	11	12.9	1.4	5.4	5.8	

CONCLUSIONS: Bottom condition is poor in the Trenton Channel as far south as Pointe Mouillee. Bottom conditions east of Grosse Ile vary from fair to good.


AREA LOCATION MAP
LAKE HURON
PORT HURON
MICHIGAN
LAKE ST CLAIR
DETROIT
WINDSOR
ONTARIO
LAKE ERIE
TOLEDO
MICHIGAN
LAKE ST CLAIR
BELLE ISLE
DETROIT
WINDSOR
ONTARIO
RIVER ROUGE
ECORSE
LEGEND
Location of Bottom Sampling Stations
GOOD Natural bottom condition
FAIR Natural bottom condition with some evidence of deposited materials, moderate amounts of waste associated material
POOR Bottom deposits of organic or other material having black oily appearance and odor of oil or sewage. Large amounts of waste associated material
No Samples Taken

a 181

POOR: Bottom deposits of organic or other material having black oily appearance and odor of oil or sewage. Large amounts of waste associated material
No Samples Taken
RIVER ROUGE
ONTARIO
ECORSE
Ecorse River
FIGHTING ISLAND
WYANDOTTE
RIVERVIEW
Monguagon Creek
TRENTON
GROSSE ILE
Stony Island
GROSSE ILE NAVAL AIR STATION
Swan Island
Elba Island
BOIS BLANC ISLAND
AMHERSTBURG
GIBRALTAR
Hickory Island
Sugar Island
Horse Island
Celeron Island
Sturgeon Bar

221 C

FIGURE 23-V

DETROIT RIVER-LAKE ERIE PROJECT

CLASSIFICATION OF BOTTOM CONDITION AS INDICATED BY BOTTOM DEPOSITS

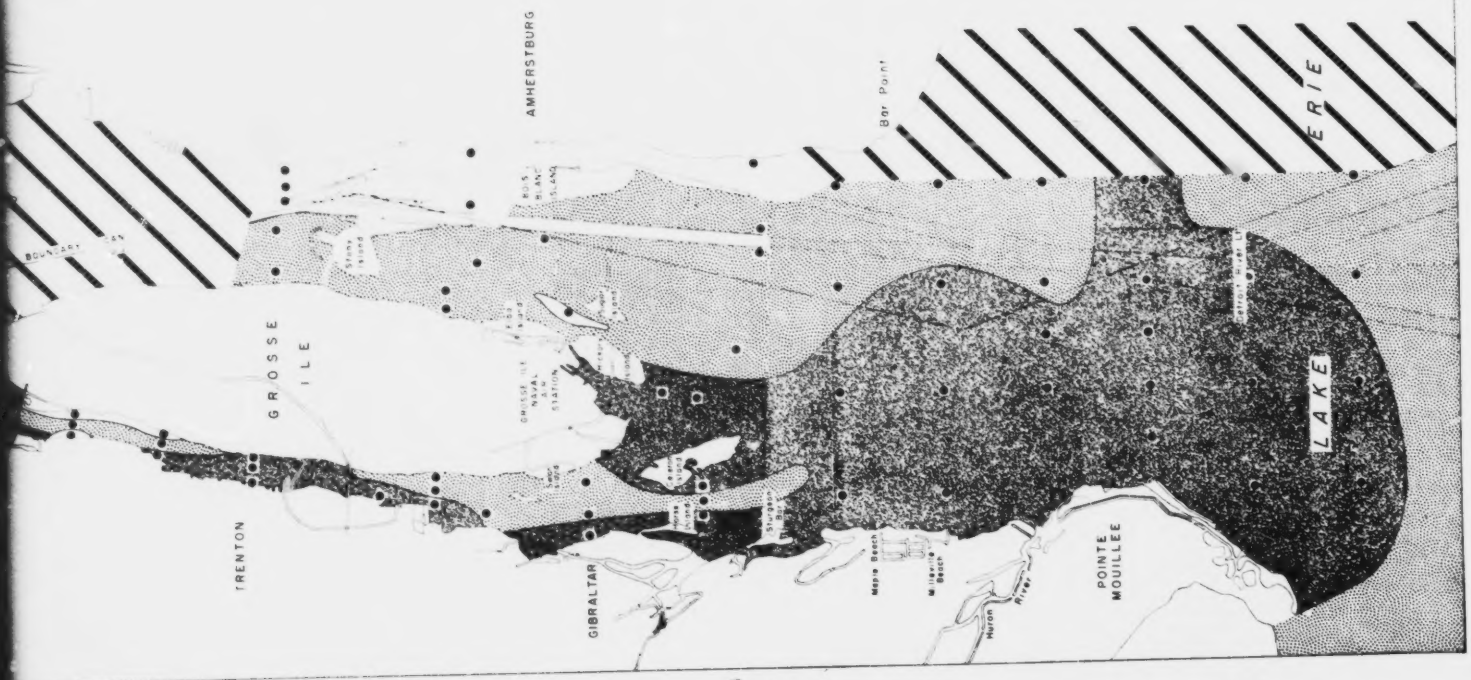
DETROIT RIVER

U.S. DEPARTMENT OF HEALTH, EDUCATION, AND WELFARE
PUBLIC HEALTH SERVICE
REGION V GROSSE ILE, MICHIGAN

SCALE

FEET

MILES



221 C

Hydrologic Studies

Several investigations of hydraulic and hydrologic characteristics were made on the Detroit River to provide insight into the relationship between sources of wastes and areas affected by pollution. Flow distribution in the Detroit River was determined at several locations and routes of wastes traced from their source to downstream areas of water use. Dispersion patterns of domestic and industrial waste effluents were determined and plotted.

Flow Distribution

In Figures 24-V and 25-V flow distribution across the upper and lower Detroit River is shown. These figures depict streamlines or distribution of per cent of flow across the Detroit River at varying ranges. The numbers shown adjacent to the streamlines represent the per cent flow west of the particular line. The per cent flow in United States waters varied from approximately 70 per cent at the head and opposite Fighting Island to less than 40 per cent at several locations, including the mouth. Velocities varied in the main part of the River between one and four feet per second, causing turbulent flow, resulting in the creation of a homogeneous mass of water in a vertical plane due to mixing. Horizontal mixing was much less pronounced due to large masses of water moving downstream at high velocities.

Dye Tracer Studies

Rhodamine-B fluorescent dye was placed in the effluent of four domestic sewage treatment plants and traced downstream. Floats were placed in the River to assist in tracing the dye, which soon became invisible and had to be located with a fluorometer. Figures 26-V and 27-V depict the results of these surveys in the upper and lower Detroit River by plotting the extent of dye as a shaded area and the major concentration of the dye as a solid heavy line with direction arrows. No attempt was made to draw any conclusions regarding the expected concentration of wastes from the observed concentration of dye at any point. In addition to placing dye in sewage plant effluents, several tracer runs were made after release of dye in several areas of the Detroit River from its head to its mouth.

One tracer study was made at the Belle Isle sewage treatment plant, and the results (Figure 26-V) showed that the dye stayed in the main channel of the River, dispersing gradually to a 1,000-foot width at the Ambassador Bridge. The main path of this dye passed through one of the regular sampling points at Range Dt 20.6, 700 feet from the United States shore. This is a logical explanation for the sudden peak in coliform densities noted at this location in earlier discussions. (See Figure 1-V and Figure 15-V.) This same bacterial load was missed at the sampling station immediately below the outfall due to the narrow band of pollution travelling between two regular sampling stations.

Three tracer studies were made at the main sewage treatment plant of the City of Detroit, and the path shown in Figure 26-V is the concensus of the three studies. The three studies did show approximately the same results under different conditions of wind, but during dry weather. The dye shifted gradually to midchannel and travelled to the west edge of the Fighting Island Channel but was most concentrated near the United States shore. The dye appeared to miss the new southwest water intake of the City of Detroit, but a heavy concentration of the dye passed over the City of Wyandotte water intake. Further downstream the dye was traced to the east as well as the west side of Grosse Ile at Point Hennepin, although the main concentration of the dye was observed in the Trenton Channel. In general the dye was found almost exclusively in American waters and was most concentrated approximately 700 feet from the United States shore.

Tracer studies were made at the Wayne County Sewage Treatment Plants at Wyandotte and Trenton. The dye was traced down the Trenton Channel and between Horse Island and Celeron Island at the lower end of the channel. The dye was most intense near the mainland shore. In both studies dye was found in marinas along the shore.

Using the results of the flow distribution, tracer studies from domestic waste plants, and special dye studies at various locations in the Detroit River, Figure 28-V was constructed to show the expected routing or dispersion of industrial or domestic waste discharged into the river at different geographic zones. Use of this figure can be illustrated by the following example:

> The wastes from the industries in zone 1 are expected to be dispersed in the River to the west of the zone line beginning at the upper end of zone 1. Opposite the Ecorse River, wastes from zone 1 are dispersed throughout the entire United States section of the River, while wastes from zone 4 hug a narrow band near the United States shore.

Using Figures 28-V, 24-V, and 25-V, it is possible to predict the downstream areas where wastes from specific sources are felt and also possible to predict areas where water quality improvement would result after improved waste treatment at specific sources.

Table 26-V shows the percentage of the Detroit River affected by the discharge of industrial and domestic wastes from the Michigan mainland. The zone numbers correspond to those shown in Figure 26-V.

The outflow of the Rouge River was traced into the Detroit River and downstream a short distance. The Rouge River and effluent from the submerged outfall of the Detroit Sewage Treatment Plant are clearly identifiable by color as two distinct water masses at their junction near the mouth of the Rouge River. However, these two water masses become intermixed due to turbulence and diffusion and for all practical purposes act as a single water mass passing downstream. Dye releases from the Detroit Sewage Treatment Plant outfall were therefore used to trace the downstream movement of this combined flow. These flow measurements were performed during dry weather and represent normal or even below normal discharge from the Rouge River. It is conceivable and even probable that following a heavy rainfall with subsequent overflows from combined sewers on the Rouge River that its increased discharge would have a more pronounced effect on the dispersion of the combined water masses towards Canadian waters and have a more deleterious effect on water quality at the southwest intake of the City of Detroit.

Stream Loadings

When concentrations of waste constituents in the Detroit River are compared with corresponding discharge values for each section of the River sampled, quantitative loadings may be computed. These are usually reported in units such as pounds, gallons, or numbers. An average concentration of a waste constituent weighted to discharge may also be computed. This procedure allows the presentation of one value at each range or cross-section representative of existing concentrations and amounts of waste present. Stream loadings are useful in presenting a concise picture of what is happening in the river from the headwaters to the mouth. They may also be used in comparison with loadings from domestic and industrial waste effluents.

A special problem is involved when numbers of coliform organisms are presented. Their values are so high that they are awkward to work with and comprehend. To allow a better understanding of these values, the bacterial population equivalent (BPE) has been employed. This is a value equivalent to the daily bacterial contribution from one human being in raw sewage. The value used for one BPE is 200 billion coliform bacteria per day per capita. Use of the BPE should give the reader of this report a better understanding of the magnitude of increases and decreases in numbers of coliform organisms in the Detroit River and assist in the evaluation of the effect of waste sources upon these numbers.

Tables 27-V through 38-V show stream loadings for phenols, chlorides, and total coliform organisms at several ranges in the Detroit River during the 1962 and 1963 sampling seasons. The total loadings for the United States and entire River are shown as well as percent flow at each section sampled. Table 39-V shows the increase in stream loadings for these same waste constituents by listing the values in the upper and lower section of the Detroit River. In this particular table the loadings in the upper River were adjusted to the same volume of the River found in United States waters at the mouth. This gives a more valid indication of increase in loadings due to waste discharge, since almost all wastes discharged into the Detroit and Rouge Rivers remain in United States waters. Table 40-V compares the increase in waste loadings in the Detroit River with loadings found in the domestic and industrial waste surveys.

Figures 29-V through 37-V depict stream loadings at several key locations in the Detroit River for total coliform organisms, phenols, chlorides, phosphates, total nitrogen, ammonia, suspended solids, iron, and nitrates respectively. Figures 38-V through 46-V depict average concentrations for these same constituents weighted to flow for the entire range. Table 41-V is included to show bacterial loadings and weighted average total coliform concentrations during wet and dry conditions.

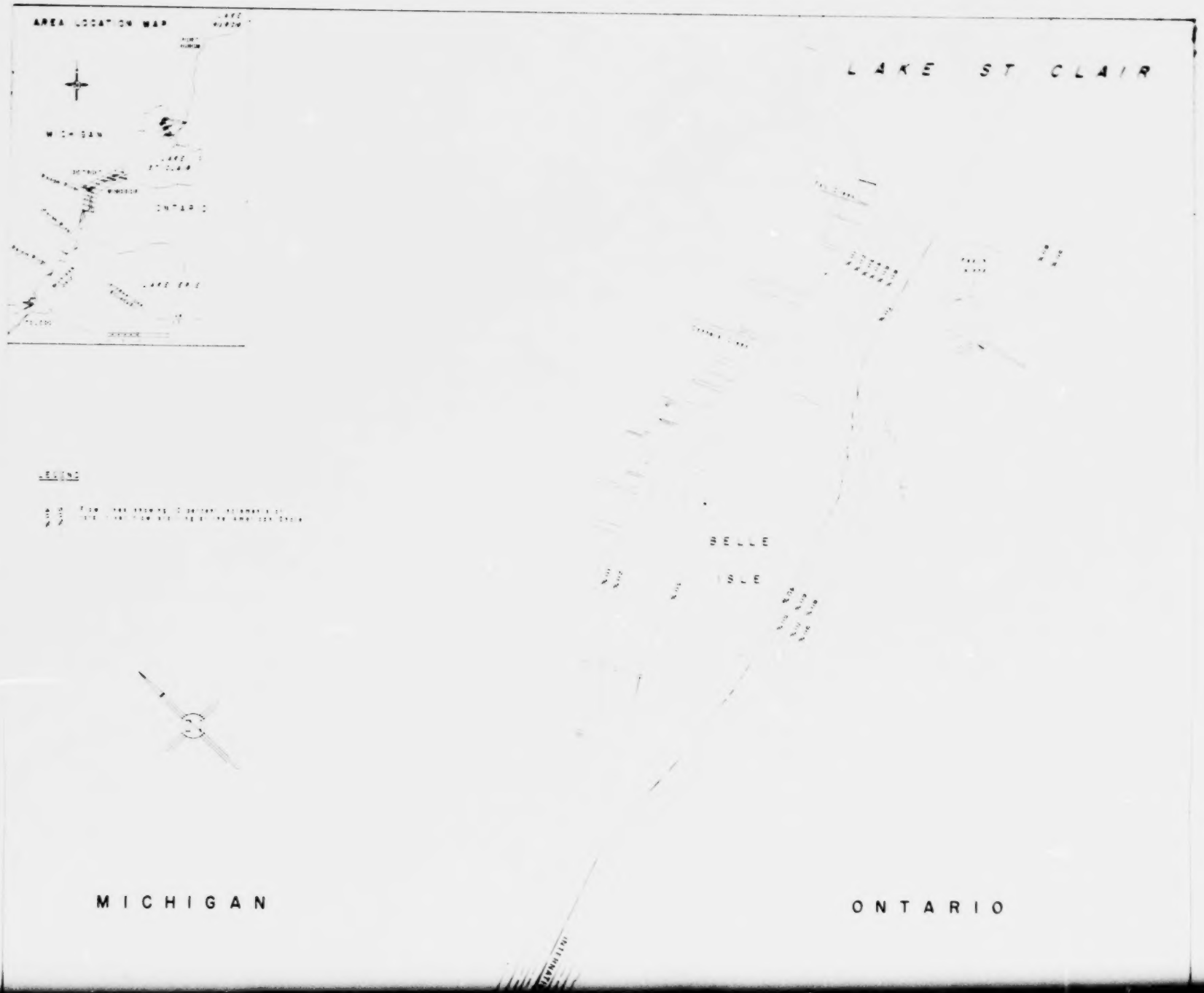
As shown by the graphs, there was a noticeable increase in weighted average concentration in the Detroit River coliform densities, from 46 to 7,250 organisms per 100 ml. Chlorides increased from 8 to 23 mg/l and phenols showed great variability from 3.8 μg/l to 10.5 μg/l just below the Rouge to 4.9 μg/l at the mouth. The increase in essential plant nutrients was noticeable as the loadings of total nitrogen or phosphate double between the headwaters and the mouth. Iron showed a significant increase in both weighted average concentrations and loadings.

A reasonable portion of the increase in stream loadings is accounted for in the loadings computed from domestic and industrial waste surveys.

Summaries of Detroit River tributary stream loadings and weighted average concentrations for nitrogen compounds, phosphates, total coliform organisms, phenols, and chlorides are shown in Table 42-V. The tributaries covered in this summary are the Rouge River, Ecorse River, and Monguagon Creek.

Study of the tributaries revealed the Rouge River to be a major contributor of coliform organisms, phenols, and chlorides. Further study of the records revealed a dramatic bacterial improvement in the Rouge in 1963 with a 42 per cent reduction in coliform loadings. Phenol loadings, on the other hand, increased 54 per cent, and chlorides stayed constant. The Ecorse River is a small contributor of highly concentrated bacterial waste, while Monguagon Creek is a major contributor of phenolic wastes with 102 pounds per day. The Rouge River is a significant source of phosphates, ammonia, nitrates, and organic nitrogen.

The variable phenol values found at the head of the Detroit River posed an investigative problem. Records of the Detroit Field Unit of the International Joint Commission were studied, and it was found that the weighted average concentration in the St. Clair River was 9 $\mu g/l$, and loading was 8,700 pounds per day. Known sources of phenolic waste are located in the upper part of the St. Clair River at Sarnia, Ontario and are believed to be the major source of this waste constituent.


AREA LOCATION MAP
LAKE ST CLAIR
BELLE
ISLE
MICHIGAN
ONTARIO

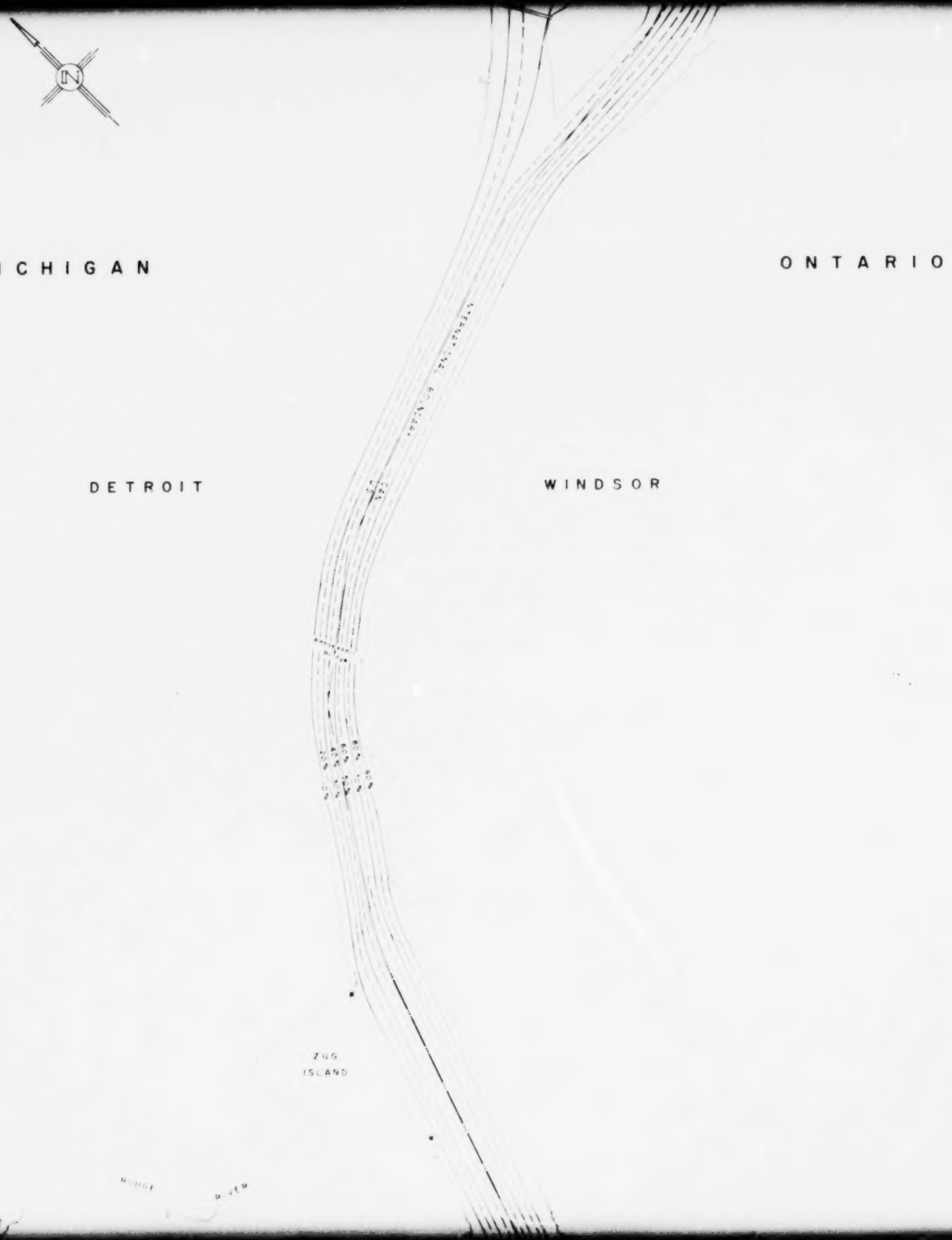


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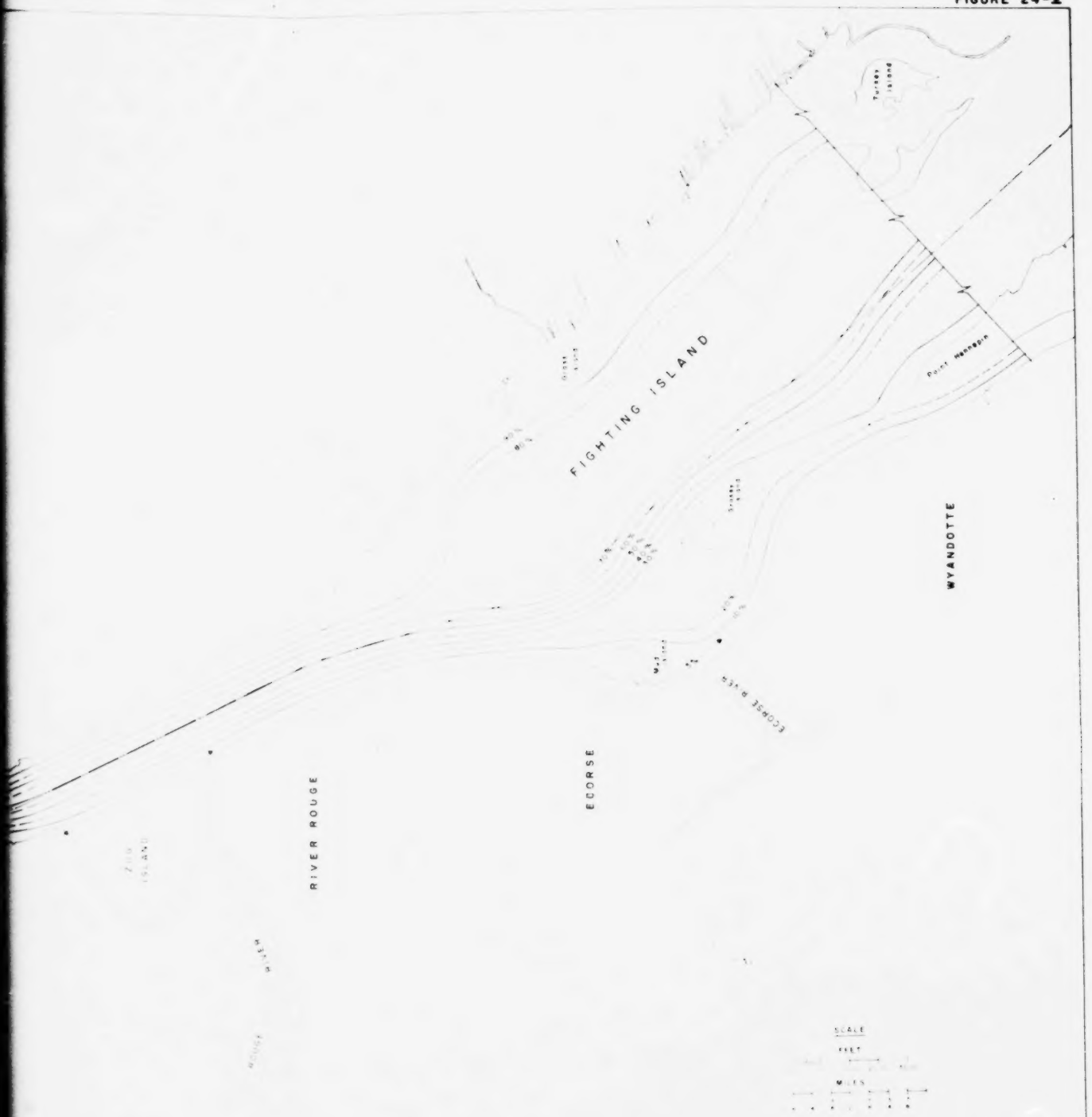
FIGURE 24-V

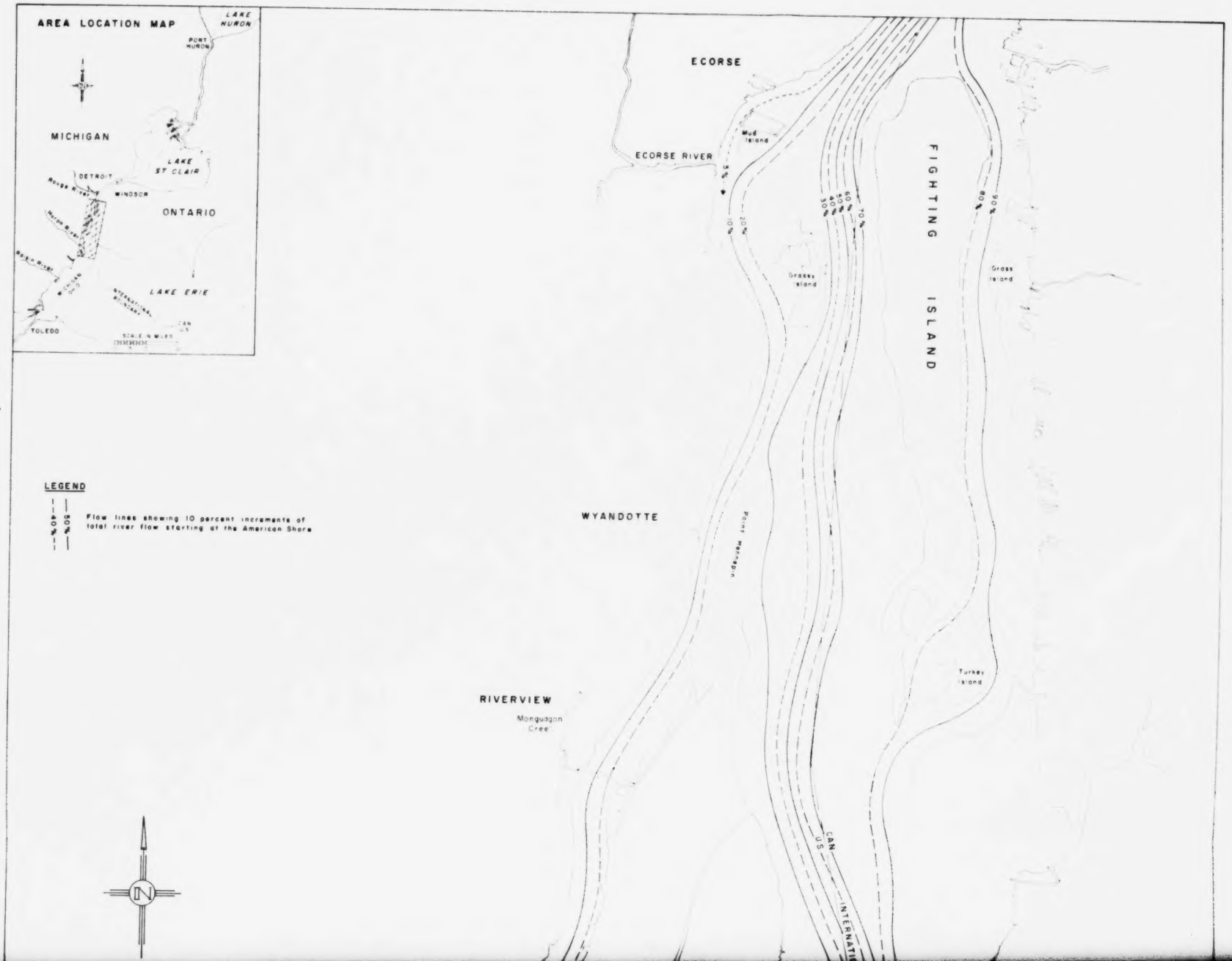


DETROIT RIVER-LAKE ERIE PROJECT

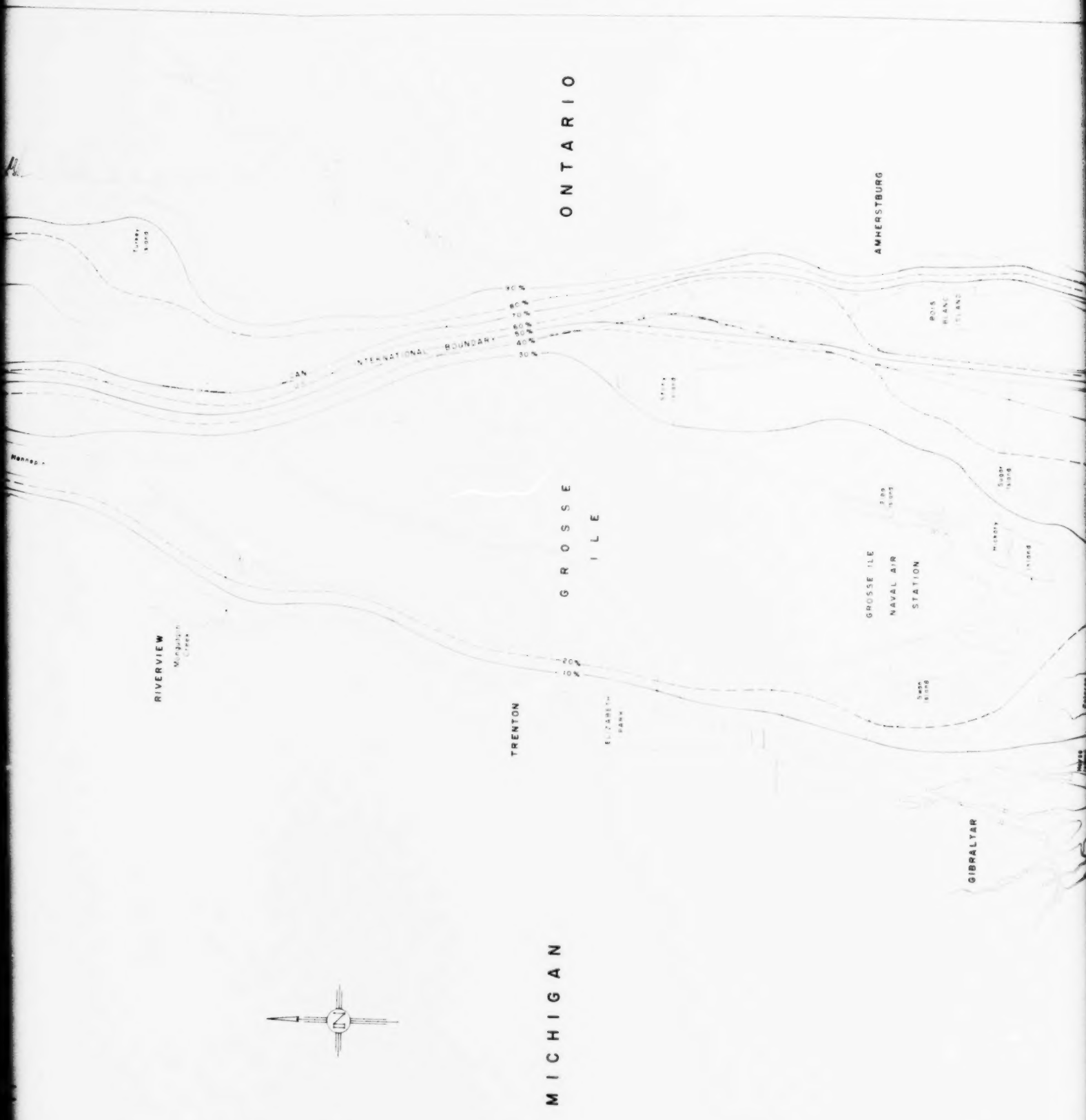
DISTRIBUTION OF FLOW

UPPER DETROIT RIVER

U.S. DEPARTMENT OF HEALTH, EDUCATION, AND WELFARE
PUBLIC HEALTH SERVICE
REGION V GROSSE ILE, MICHIGAN


AREA LOCATION MAP
LAKE HURON
PORT HURON
MICHIGAN
LAKE ST CLAIR
DETROIT
WINDSOR
ONTARIO
LAKE ERIE
TOLEDO
ECORSE
ECORSE RIVER
Mud Island
FIGHTING ISLAND
Grassy Island
Grass Island
Turkey Island
WYANDOTTE
Perry Meridian
RIVERVIEW
Monguagon Cree
CAN
US
INTERNATIONAL
LEGEND
Flow lines showing 10 percent increments of total river flow starting at the American Shore

225 d


ONTARIO
AMHERSTBURG
INTERNATIONAL BOUNDARY
90%
80%
70%
60%
50%
40%
30%
20%
10%
GROSSE ILE
GROSSE ILE NAVAL AIR STATION
RIVERVIEW
TRENTON
GIBRALTAR
MICHIGAN
N

225 e

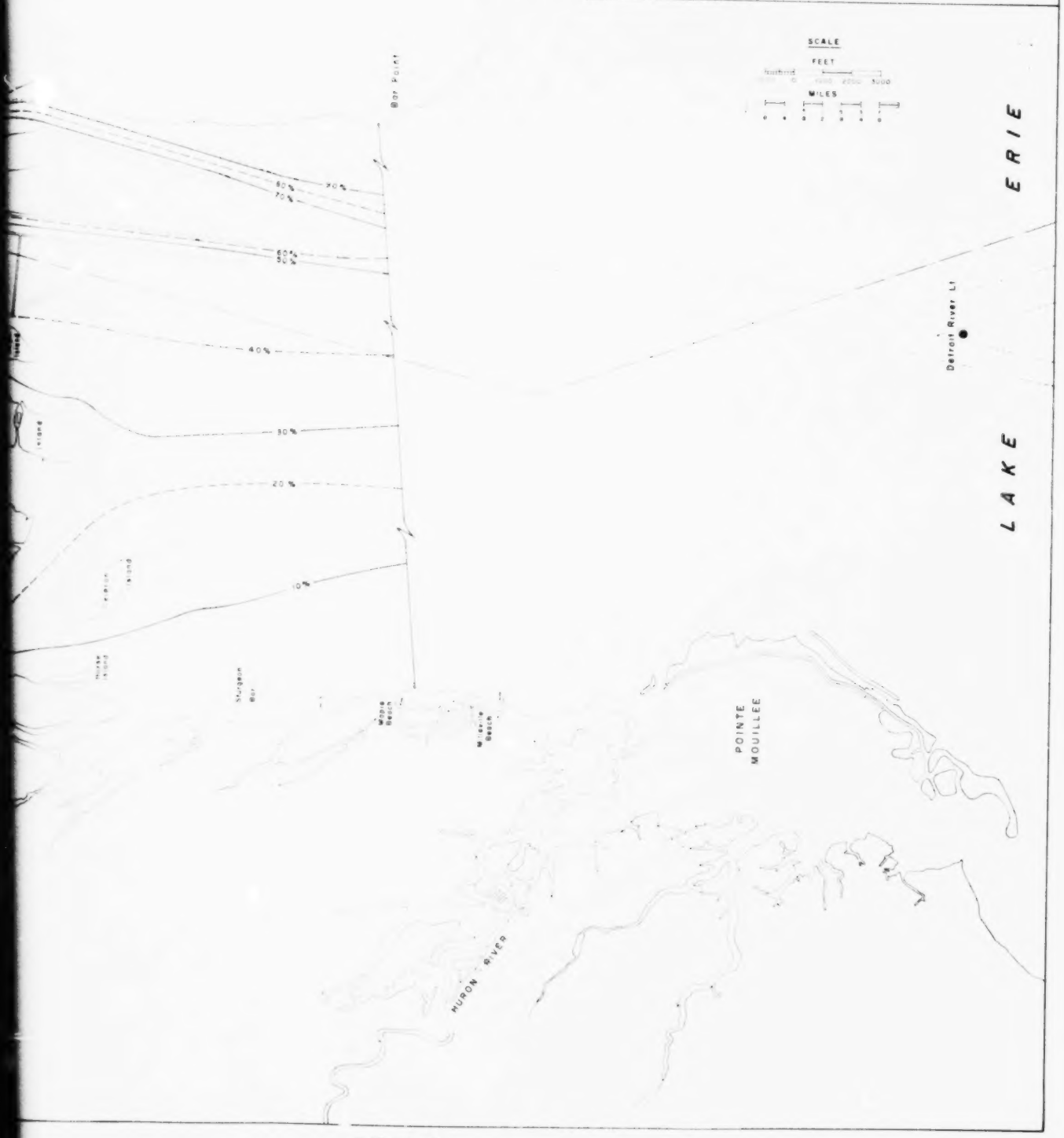
FIGURE 25-V

DETROIT RIVER–LAKE ERIE PROJECT

DISTRIBUTION OF FLOW

LOWER DETROIT RIVER

U.S. DEPARTMENT OF HEALTH, EDUCATION, AND WELFARE
PUBLIC HEALTH SERVICE
REGION V GROSSE ILE, MICHIGAN



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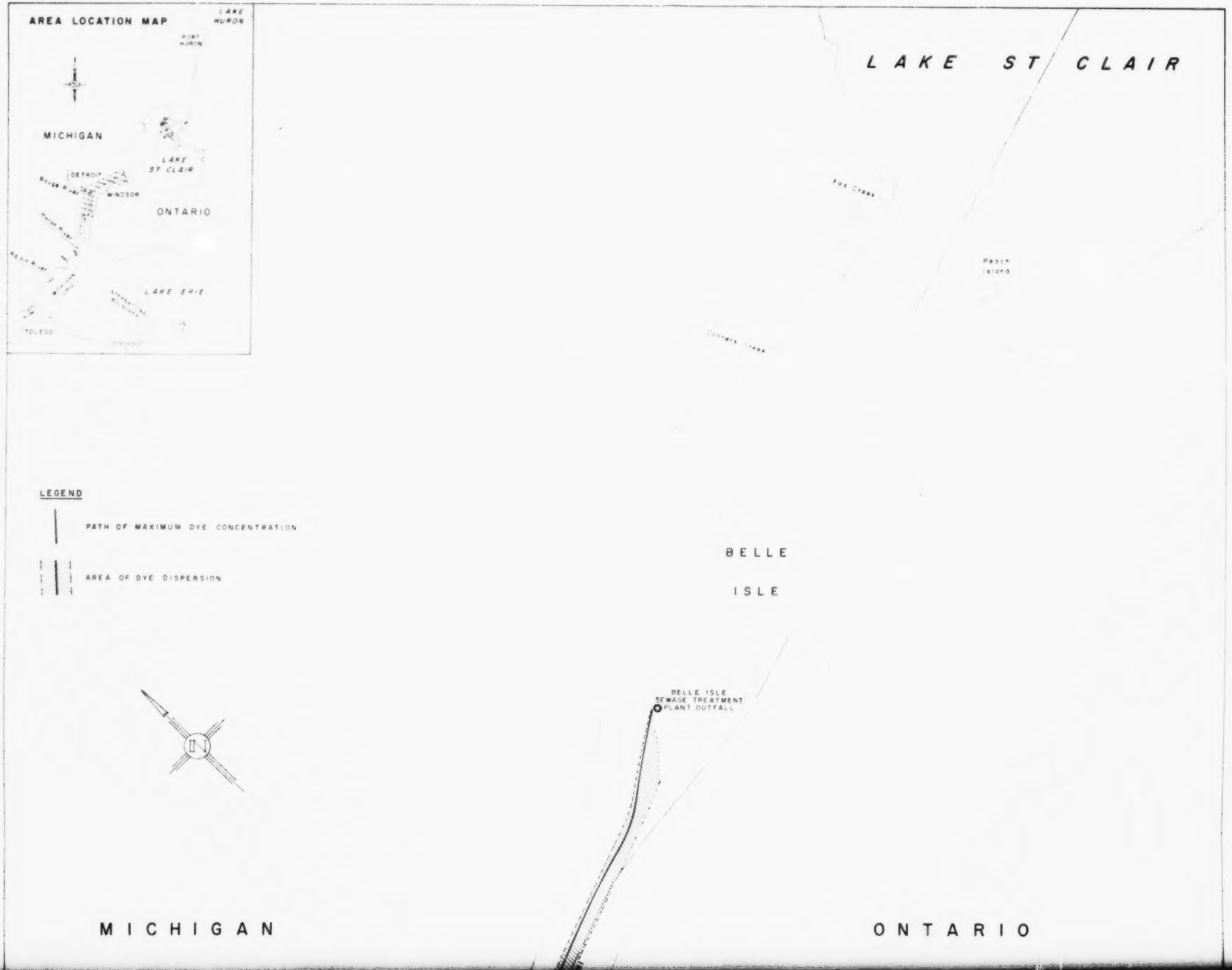
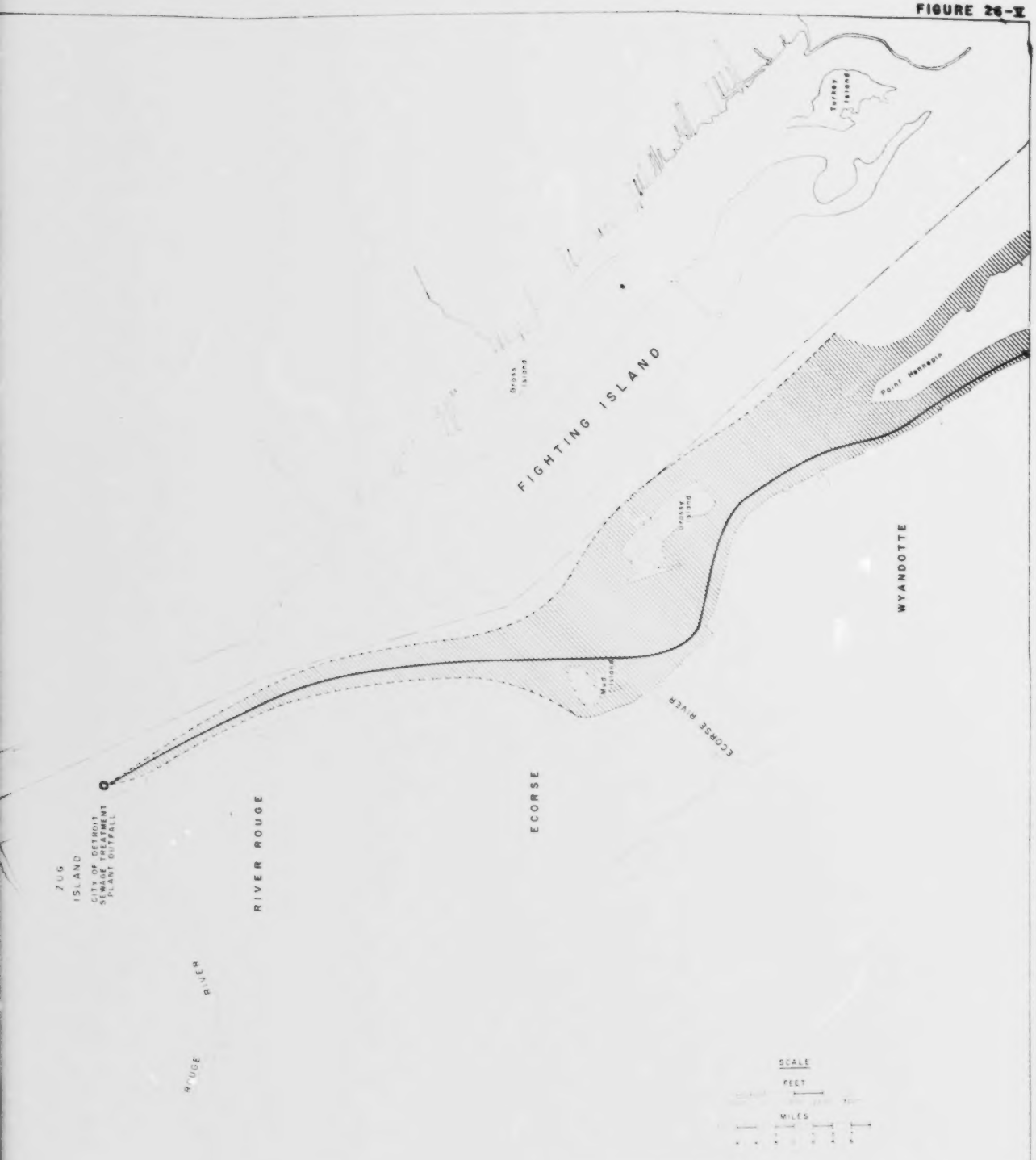

AREA LOCATION MAP
LAKE HURON
PORT HURON
MICHIGAN
LAKE ST CLAIR
DETROIT
ROUGE RIVER
WINDSOR
ONTARIO
LAKE ERIE
TOLEDO
LAKE ST CLAIR
Fox Creek
Peach Island
Conners Creek
LEGEND
PATH OF MAXIMUM DYE CONCENTRATION
AREA OF DYE DISPERSION
BELLE ISLE
BELLE ISLE SEWAGE TREATMENT PLANT OUTFALL
N
MICHIGAN
ONTARIO

225 A

MICHIGAN
ONTARIO
DETROIT
WINDSOR
ZUG
ISLAND
CITY OF DETROIT
SEWAGE TREATMENT
PLANT OUTFALL
ROUGE
RIVER
RIVER ROUGE

FIGURE 26-X



DETROIT RIVER–LAKE ERIE PROJECT

DYE TRACER STUDIES

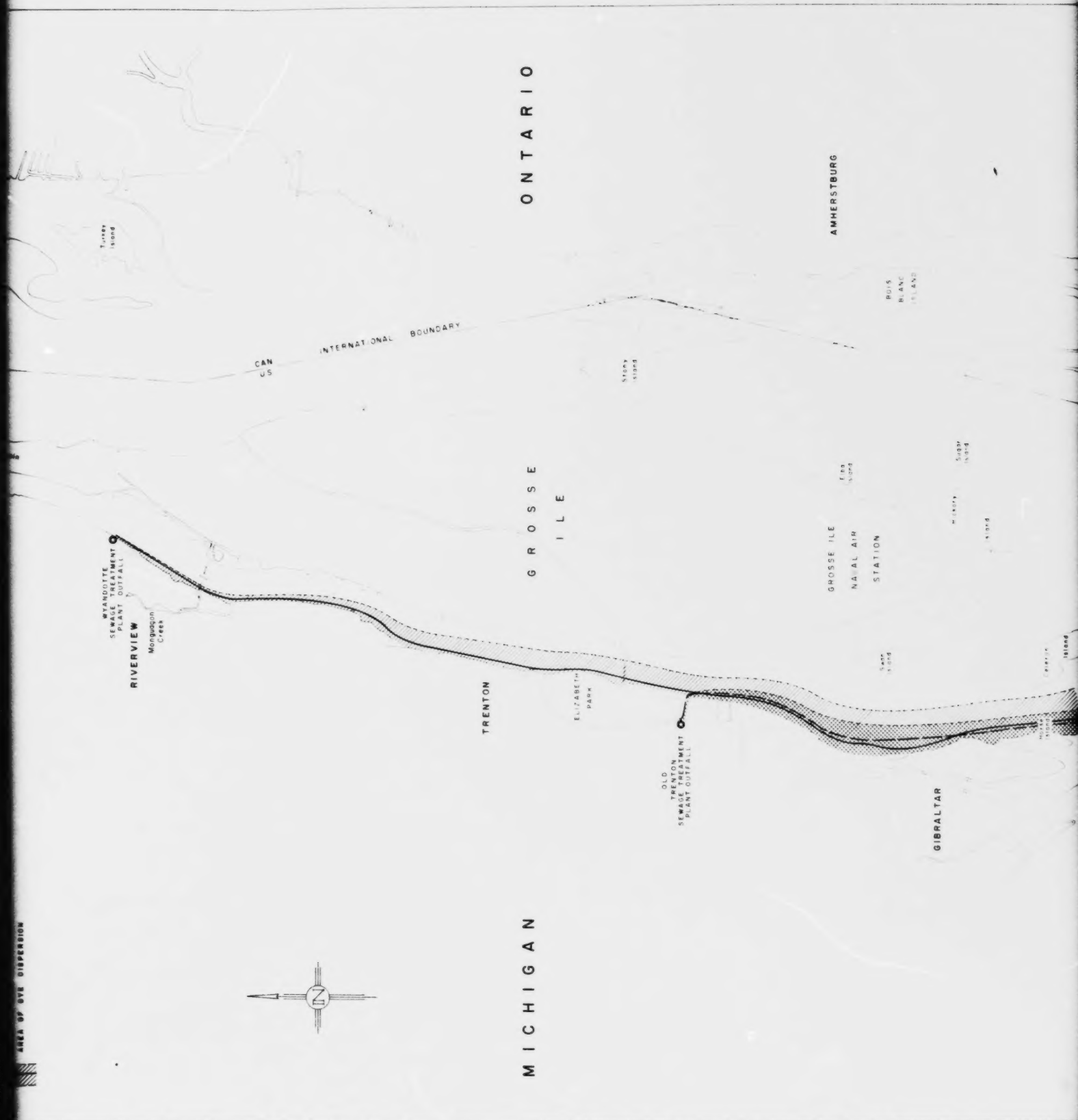
UPPER DETROIT RIVER

U.S. DEPARTMENT OF HEALTH, EDUCATION, AND WELFARE
PUBLIC HEALTH SERVICE
REGION V GROSSE ILE, MICHIGAN

225 i

AREA LOCATION MAP
LAKE HURON
PORT HURON
MICHIGAN
LAKE ST CLAIR
DETROIT
WINDSOR
ONTARIO
LAKE ERIE
TOLEDO
ECORSE
ECORSE RIVER
Mud Island
FIGHTING ISLAND
Grassy Island
Grassy Island
WYANDOTTE
Turkey Island
WYANDOTTE SEWAGE TREATMENT PLANT OUTFALL
RIVERVIEW
Monguagon Creek
CAN
US
INTERNAT
LEGEND
PATH OF MAXIMUM DYE CONCENTRATION
AREA OF DYE DISPERSION
N

3357


ONTARIO
MICHIGAN
AMHERSTBURG
GROSSE ILE
GROSSE ILE NAVAL AIR STATION
GIBRALTAR
TRENTON
RIVERVIEW
WYANDOTTE SEWAGE TREATMENT PLANT OUTFALL
OLD TRENTON SEWAGE TREATMENT PLANT OUTFALL
ELIZABETH PARK
Monguagon Creek
CAN
US
INTERNATIONAL BOUNDARY
Turkey Island
Stony Island
Elba Island
Sugar Island
Hickory Island
Swan Island
Celeron Island
Horse Island
BOIS BLANC ISLAND
AREA OF OVE DISPERSION

225 k

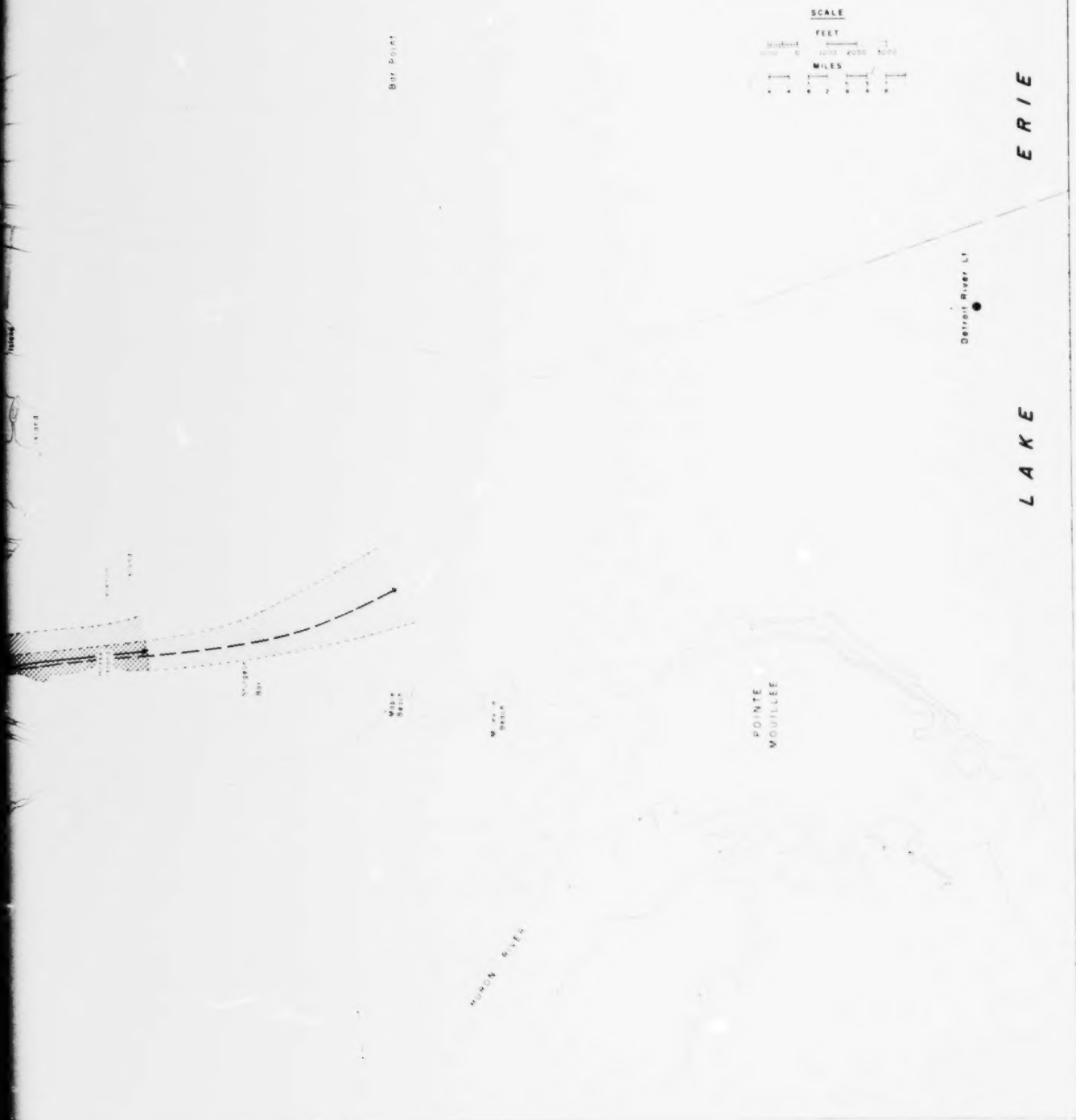
FIGURE 27-V

DETROIT RIVER–LAKE ERIE PROJECT

DYE TRACER STUDIES

LOWER DETROIT RIVER

U S DEPARTMENT OF HEALTH, EDUCATION, AND WELFARE
PUBLIC HEALTH SERVICE
REGION V GROSSE ILE, MICHIGAN

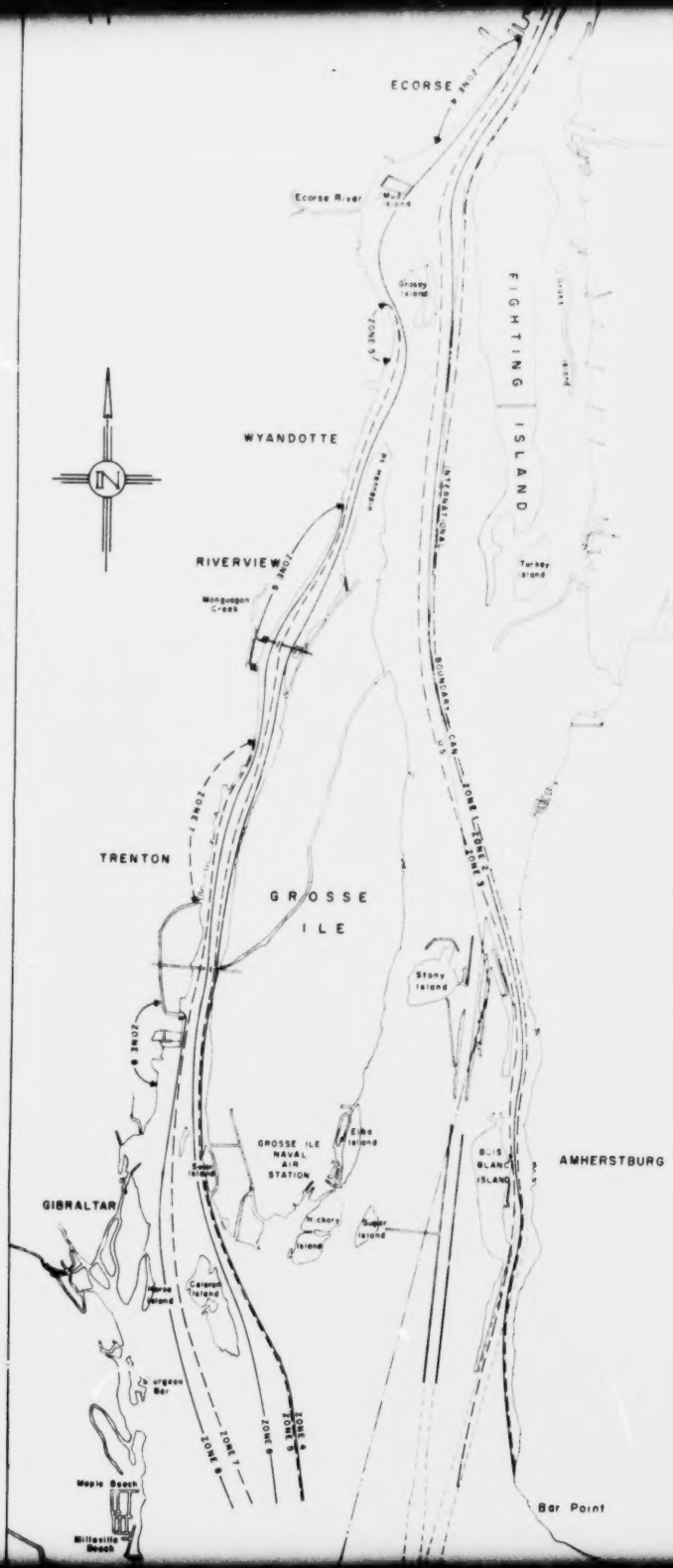


225 l

AREA LOCATION MAP
LAKE HURON
PORT HURON
MICHIGAN
LAKE ST CLAIR
DETROIT
WINDSOR
ONTARIO
LAKE ERIE
TOLEDO
SCALE IN MILES
MICHIGAN
DETROIT
WINDSOR
ONTARIO
LAKE ST CLAIR
BELLE ISLE
ZONE 1
ZONE 2
ZONE 3
ZONE 4
ZONE 5
ROUGE RIVER
ZUG ISLAND
RIVER ROUGE
ECORSE
Ecorse River
Mud Island
Grassy Island
FIGHTING
LEGEND
Zone of shore line in which waste outfalls are located
Extent of horizontal dispersion of effluents from a zone under average conditions of wind and river flow

225 mm

ONTARIO



225 m

FIGURE 28-V

DETROIT RIVER-LAKE ERIE PROJECT

ZONES OF WASTE DISPERSION AFTER DISCHARGE

U.S. WATERS
DETROIT RIVER

U.S. DEPARTMENT OF HEALTH, EDUCATION, AND WELFARE
PUBLIC HEALTH SERVICE
REGION V GROSSE ILE, MICHIGAN

2250

TABLE 26-V. INDUSTRIAL AND MUNICIPAL WASTE DISPERSION - PERCENTAGE OF DETROIT RIVER

Cross-Sectional Location	Waste Source - Zones							
	1	2	3	4	5	6	7	8
Ambassador Bridge	25							
Dt 19.0 (Rouge R.)	50	30						
Dt 17.4W	70	50	40	10				
Dt 14.6W	70	60	50	20	5			
Dt 12.0	70	70	60	23	20	5		
Dt 8.7	80	80	70	23	23	15	7	
Dt 3.9	100	100	80	25	25	20	15	10

Note: Percentage flow values are computed from the west (American) shore

TABLE 27-V. STREAM LOADING FOR DETROIT RIVER

DT 30.8W

1962

Feet*	% Flow	Phenols lb./day	Chloride lb./day	Coliform BPE
20	.33	7	20,000	12
100	1.57	32	90,000	50
200	3.39	52	202,000	120
300	3.58	42	206,000	110
400	3.92	90	202,000	74
500	6.41	150	330,000	110
700	12.86	400	690,000	180
1,000	34.76	570	1,734,000	380
2,000	24.96	290	1,446,000	240
2,500	3.16	67	180,000	24
U.S. Water	94.94	1,700	5,100,000	1,300
Entire Range	100	1,800	5,400,000	1,300
Weighted Average - U.S. Water		2.4 µg/l	7 mg/l	80 org/100ml
Weighted Average - Entire Range		2.4 µg/l	7 mg/l	79 org/100ml

1963

100	3.59	55	110,000	30
300	6.24	370	384,000	85
500	14.80	410	554,000	50
1,000	51.19	1,690	2,990,000	65
2,500	24.18	1,325	2,222,000	40
U.S. Water	94.94	3,850	6,260,000	270
Entire Range	100	4,050	6,660,000	271
Weighted Average - U.S. Water		6.0 µg/l	10 mg/l	18 org/100ml
Weighted Average - Entire Range		6.0 µg/l	10 mg/l	15 org/100ml

* Location of sampling station in feet from west shore

TABLE 28-V. STREAM LOADING FOR DETROIT RIVER

DT 28.4 W

1962

Feet*	% Flow	Phenols lb./day	Chloride lb./day	Coliform BPE
100	7.41	40	200,000	650
200	5.52	15	136,000	131
300	5.82	25	134,000	133
400	12.21	70	284,000	210
700	20.26	45	500,000	300
1,000	16.48	55	370,000	174
1,300	13.08	30	290,000	82
1,500	19.22	70	426,000	220
U.S. Water	100	350	2,340,000	1,900
Entire Range	100	350	2,340,000	1,900
Weighted Average - U.S. Water		1.2 µg/l	8 mg/l	320 org/100ml
Weighted Average - Entire Range		1.2 µg/l	8 mg/l	320 org/100ml

1963

100	10.17	50	154,000	127
300	11.92	210	498,000	133
700	34.60	350	408,000	42
1,300	43.31	740	980,000	78
U.S. Water	100	1,350	2,040,000	380
Entire Range	100	1,350	2,040,000	380
Weighted Average - U.S. Water		4.6 µg/l	7 mg/l	70 org/100ml
Weighted Average - Entire Range		4.6 µg/l	7 mg/l	70 org/100ml

* Location of sampling station in feet from west shore

TABLE 29-V. STREAM LOADING FOR DETROIT RIVER

DT 25.7

1962

Feet*	% Flow	Phenols lb./day	Chloride lb./day	Coliform BPE
50	.56	15	46,000	340
100	2.37	140	194,000	740
300	5.19	50	372,000	570
600	9.06	120	660,000	440
1,000	17.32	155	1,294,000	470
2,000	18.04	220	1,294,000	340
U.S. Water	52.54	700	3,860,000	2,900
Entire River	100	1,300	7,540,000	9,200
Weighted Average - U.S. Water		1.4 µg/l	7 mg/l	170 org/100ml
Weighted Average - Entire River		1.3 µg/l	8 mg/l	390 org/100ml

1963

50	.56	18	38,000	250
100	2.37	112	152,000	530
300	5.19	247	352,000	560
600	9.06	791	564,000	190
2,000	37.36	2,282	2,574,000	170
U.S. Water	54.54	3,450	3,680,000	1,700
Entire River	100	6,250	7,660,000	36,700
Weighted Average - U.S. Water		7.2 µg/l	8 mg/l	150 org/100ml
Weighted Average - Entire River		6.7 µg/l	8 mg/l	1,740 org/100ml

* Location of sampling station in feet from west shore

TABLE 30-V. STREAM LOADING FOR DETROIT RIVER

DT 20.6

1962

Feet*	% Flow	Phenols lb./day	Chloride lb./day	Coliform BPE
5	.08	1	8,000	40
20	.21	4	18,000	220
50	.71	15	60,000	530
100	1.94	55	146,000	1,370
200	3.57	85	284,000	3,210
300	4.47	85	360,000	1,750
400	5.08	120	440,000	1,610
500	5.28	155	450,000	520
600	5.62	140	480,000	550
700	11.24	220	894,000	910
1,000	11.88	270	1,000,000	790
U.S. Water	50.08	1,150	4,140,000	12,000
Entire River	100	1,850	8,480,000	82,000
Weighted Average - U.S. Water		2.7 µg/l	8 mg/l	1,000 org/100ml
Weighted Average - Entire River		1.8 µg/l	8 mg/l	3,600 org/100ml

1963

5	.18	6	6,000	13
50	1.79	783	58,000	130
200	6.77	419	330,000	1,040
400	10.00	1,629	948,000	3,800
600	8.31	750	350,000	707
700	11.29	793	780,000	1,440
1,000	11.74	1,070	820,000	1,370
U.S. Water	50.08	5,450	3,300,000	8,500
Entire River	100	10,100	6,440,000	30,900
Weighted Average - U.S. Water		11.6 µg/l	7 mg/l	730 org/100ml
Weighted Average - Entire River		10.8 µg/l	8 mg/l	1,460 org/100ml

* Location of sampling station in feet from west shore

TABLE 31-V. STREAM LOADING FOR DETROIT RIVER

DT 19.0

1963

Feet*	% Flow	Phenols lb./day	Chloride lb./day	Coliform BPE
100	1.74	452	564,000	3,100
200	2.72	504	774,000	9,600
300	4.03	600	1,186,000	12,800
400	12.33	2,030	3,076,000	35,600
800	15.43	340	2,150,000	3,570
1,000	15.06	1,124	1,190,000	2,330
U.S. Water	51.31	5,050	8,940,000	67,000
Entire River	100	6,380	12,780,000	81,500
Weighted Average - U.S. Water		10.5 µg/l	19 mg/l	5,700 org/100ml
Weighted Average - Entire River		7.2 µg/l	14 mg/l	3,870 org/100ml

* Location of sampling station in feet from west shore

TABLE 32-V. STREAM LOADING FOR DETROIT RIVER

DT 17.4 W

1962

Feet*	% Flow	Phenols lb./day	Chloride lb./day	Coliform BPE
100	1.21	67	212,000	2,200
200	4.41	243	710,000	10,600
400	10.74	590	1,450,000	18,700
600	11.87	555	1,320,000	19,000
800	10.85	750	1,270,000	16,400
1,000	10.86	390	1,202,000	13,900
1,200	10.98	250	1,004,000	8,000
1,400	10.98	265	950,000	6,800
1,600	14.38	390	1,222,000	4,400
U.S. Water	86.28	3,500	9,340,000	100,000
Entire Range	100	3,800	10,340,000	110,000
Weighted Average - U.S. Water		5.2 µg/l	14 mg/l	6,600 org/100ml
Weighted Average - Entire Range		4.8 µg/l	13 mg/l	5,900 org/100ml

1963

100	1.21	148	226,000	650
200	4.41	442	792,000	3,660
400	16.67	895	1,670,000	7,600
800	28.22	1,545	4,190,000	14,200
1,200	22.40	520	1,656,000	3,500
1,600	13.37	200	886,000	1,390
U.S. Water	86.28	3,750	9,420,000	31,000
Entire Range	100	3,920	10,260,000	32,100
Weighted Average - U.S. Water		5.9 µg/l	15 mg/l	2,100 org/100ml
Weighted Average - Entire Range		5.3 µg/l	14 mg/l	1,920 org/100ml

* Location of sampling station in feet from west shore

TABLE 33-V. STREAM LOADING FOR DETROIT RIVER

DT 14.6W

1962

Feet*	% Flow	Phenols lb./day	Chloride lb./day	Coliform BPE
20	.35	15	190,000	80
100	1.55	80	450,000	4,850
200	2.66	103	470,000	7,150
300	2.93	340	546,000	3,950
400	4.74	201	530,000	9,750
600	6.93	283	690,000	14,100
800	5.58	148	550,000	9,520
900	3.62	121	326,000	5,300
1,000	3.62	79	328,000	5,800
1,100	12.18	231	1,350,000	17,300
2,000	2.20	11	120,000	1,900
2,300	34.98	20	110,000	1,450
3,000	13.76	518	4,600,000	36,700
U.S. Water	95.10	2,150	10,260,000	117,850
Entire Range	100	2,300	11,560,000	130,000
Weighted Average - U.S. Water		2.8 µg/l	14 mg/l	6,881 org/100ml
Weighted Average - Entire Range		2.8 µg/l	15 mg/l	7,000 org/100ml

1963

20	.35	22	150,000	770
100	1.55	98	482,000	5,400
200	2.66	155	688,000	3,800
300	2.93	138	694,000	4,100
400	8.70	241	734,000	5,880
800	11.16	470	1,350,000	10,000
1,000	11.52	613	2,464,000	7,200
2,000	28.28	40	252,000	350
3,000	27.95	673	4,126,000	8,000
U.S. Water	95.10	2,450	10,940,000	45,500
Entire Range	100	2,510	11,360,000	45,600
Weighted Average - U.S. Water		3.5 µg/l	16 mg/l	2,800 org/100ml
Weighted Average - Entire Range		3.4 µg/l	15 mg/l	2,720 org/100ml

* Location of sampling station in feet from west shore

TABLE 34-V. STREAM LOADING FOR DETROIT RIVER

DT 12.0W

1962

Feet*	% Flow	Phenols lb./day	Chloride lb./day	Coliform BPE
122	15.36	200	2,252,000	3,000
322	24.24	255	2,048,000	14,500
490	19.76	240	1,086,000	3,200
670	20.77	205	926,000	26,600
880	19.87	200	868,000	25,700
U.S. Water	100	1,100	7,180,000	73,000
Entire Range	100	1,100	7,180,000	73,000
Weighted Average - U.S. Water		4.8 µg/l	31 mg/l	14,000 org/100ml
Weighted Average - Entire Range		4.8 µg/l	31 mg/l	14,000 org/100 ml

1963

122	15.36	483	1,730,000	2,200
322	24.24	875	1,870,000	3,300
670	60.40	1,242	2,840,000	10,500
U.S. Water	100	2,600	6,440,000	16,000
Entire Range	100	2,600	6,440,000	16,000
Weighted Average - U.S. Water		12.9 µg/l	31 mg/l	3,500 org/100ml
Weighted Average - Entire Range		12.9 µg/l	31 mg/l	3,500 org/100ml

* Location of sampling station in feet from west shore

770-026 O-65-16

TABLE 35-V. STREAM LOADING FOR DETROIT RIVER

DT 9.6W

1963

Feet*	% Flow	Phenols lb./day	Chloride lb./day	Coliform BPE
100	5.32	63	740,000	840
300	14.18	168	1,500,000	3,700
500	17.72	105	1,278,000	5,100
900	62.78	1,064	3,082,000	11,360
U.S. Water	100	1,400	6,600,000	21,000
Entire Range	100	1,400	6,600,000	21,000
Weighted Average - U.S. Water		6.6 µg/l	30 mg/l	4,300 org/100ml
Weighted Average - Entire Range		6.6 µg/l	30 mg/l	4,300 org/100ml

* Location of sampling station in feet from west shore

TABLE 36-V. STREAM LOADING FOR DETROIT RIVER

DT 9.3E

1962

Feet*	% Flow	Phenols lb./day	Chloride lb./day	Coliform BPE
100	.01	1	0	17
200	.01	1	0	13
500	.01	2	30,000	200
800	.32	10	28,000	600
1,200	.85	15	84,000	1,550
1,500	1.14	10	96,000	2,300
2,000	1.90	130	164,000	3,650
2,500	3.79	45	330,000	6,970
3,000	3.87	21	318,000	5,160
3,300	5.52	25	270,000	5,440
3,600	5.39	40	540,000	7,100
U.S. Water	22.81	300	1,860,000	33,000
Entire Range	100	800	8,180,000	150,000
Weighted Average - U.S. Water		1.7 µg/l	11 mg/l	8,000 org/100ml
Weighted Average - Entire Range		1.3 µg/l	11 mg/l	8,200 org/100ml

1963

100	.01	1	-	-
500	.18	12	40,000	120
1,200	1.58	43	184,000	540
2,000	3.36	86	466,000	1,270
3,000	17.68	258	1,210,000	3,070
U.S. Water	22.81	400	1,900,000	5,000
Entire Range	100	1,270	9,000,000	34,000
Weighted Average - U.S. Water		2.5 µg/l	11 mg/l	1,400 org/100ml
Weighted Average - Entire Range		2.6 µg/l	13 mg/l	2,100 org/100ml

* Location of sampling station in feet from west shore

TABLE 37-V. STREAM LOADING FOR DETROIT RIVER

DT 8.7W

1962

Feet*	% Flow	Phenols lb./day	Chloride lb./day	Coliform BPE
80	5.35	225	744,000	1,400
280	12.71	220	1,208,000	5,700
480	15.69	480	1,086,000	12,300
680	21.91	250	1,048,000	19,200
980	32.89	500	1,040,000	24,100
1,240	11.45	125	414,000	5,300
U.S. Water	100	1,800	5,540,000	68,000
Entire Range	100	1,800	5,540,000	68,000
Weighted Average - U.S. Water		7.9 µg/l	24 mg/l	13,000 org/100ml
Weighted Average - Entire Range		7.9 µg/l	24 mg/l	13,000 org/100ml

1963

80	4.49	382	716,000	750
280	11.75	477	1,320,000	500
480	15.93	415	1,336,000	1,300
680	23.04	500	2,280,000	7,300
980	28.54	573	1,456,000	8,300
1,240	16.25	253	752,000	850
U.S. Water	100	2,600	7,860,000	19,000
Entire Range	100	2,600	7,860,000	19,000
Weighted Average - U.S. Water		12.7 µg/l	38 mg/l	4,100 org/100ml
Weighted Average - Entire Range		12.7 µg/l	38 mg/l	4,100 org/100ml

* Location of sampling station in feet from west shore

TABLE 38-V. STREAM LOADING FOR DETROIT RIVER

DT 3.9

1962

Feet*	% Flow	Phenols lb./day	Chloride lb./day	Coliform BPE
1,500	2.40	155	1,710,000	5,260
2,500	3.38	300	2,290,000	9,200
3,500	3.13	210	1,444,000	10,700
4,500	3.76	240	1,180,000	30,300
5,500	4.33	155	920,000	32,700
6,500	3.38	180	522,000	18,400
7,500	4.70	208	660,000	28,600
8,500	5.71	207	700,000	16,200
9,500	5.08	130	604,000	1,550
10,500	3.53	60	390,000	3,200
11,500	4.62	155	480,000	3,890
U.S. Water	44.02	2,000	10,900,000	160,000
Entire River	100	3,800	18,560,000	250,000
Weighted Average - U.S. Water		4.5 µg/l	24 mg/l	14,000 org/100ml
Weighted Average - Entire River		3.7 µg/l	18 mg/l	11,000 org/100ml

1963

2,500	5.78	526	2,468,000	8,250
3,500	3.13	210	1,148,000	3,110
4,500	3.76	202	850,000	3,450
5,500	4.33	200	796,000	3,480
6,500	3.38	135	710,000	2,370
7,500	7.55	134	730,000	1,720
9,500	8.70	503	1,266,000	2,200
11,500	7.39	320	972,000	1,420
U.S. Water	44.02	2,230	8,940,000	26,000
Entire River	100	3,550	16,600,000	50,000
Weighted Average - U.S. Water		5.5 µg/l	22 mg/l	2,700 org/100ml
Weighted Average - Entire River		3.8 µg/l	18 mg/l	2,320 org/100ml

* Location of sampling station in feet from west shore

TABLE 39-V. SUMMARY OF CHANGE IN WASTE LOADINGS BETWEEN UPPER AND LOWER DETROIT RIVER U.S. WATERS ONLY

	Upper Detroit River	Upper * Detroit River Adjusted	Lower Detroit River	Difference**
Total Coliform Organisms BPE/day	700	440	77,000	76,560
Chlorides lbs/day	5,560,000	3,520,000	10,080,000	6,560,000
Phenols lbs/day	2,500	1,600	2,100	500
Suspended Solids lbs/day	3,900,000	2,500,000	8,600,000	6,100,000
Settleable Solids lbs/day	3,200,000	2,100,000	7,200,000	5,100,000
Iron lbs/day	106,000	67,000	260,000	193,000
Total Phosphate lbs/day	114,000	72,000	217,600	145,600
Ammonia Nitrogen lbs/day	73,700	46,700	133,200	86,500
Nitrate Nitrogen lbs/day	112,000	70,900	109,000	38,100
Organic Nitrogen lbs/day	91,200	57,800	72,600	14,800

* Upper Detroit River loadings have been adjusted for equal discharge to Lower Detroit River at mouth.

** Difference is from Lower Detroit River and adjusted Upper Detroit River.

TABLE 40-V. COMPARISON OF INCREASE IN STREAM LOADING WITH KNOWN WASTE SOURCE LOADINGS

	Increase in Detroit River*	Sum of Loadings from Waste Surveys*
Chlorides - lbs/day	6,560,000	3,320,000
Phenols - lbs/day	500	2,680
Suspended Solids - lbs/day	6,100,000	1,490,000
Settleable Solids - lbs/day	5,100,000	966,000
Iron - lbs/day	193,000	107,000
Total Phosphates - lbs/day	145,600	162,000
Ammonia Nitrogen - lbs/day	86,500	42,800
Nitrate Nitrogen - lbs/day	38,100	697
Total Nitrogen - lbs/day	143,200	60,700

*U.S. Waters

TABLE 41-V. BACTERIAL LOADINGS AND WEIGHTED AVERAGE CONCENTRATIONS

DURING WET AND DRY CONDITIONS - DETROIT RIVER

UNITED STATES WATERS

Range	DRY $\bar{X}_w$**	DRY B.P.E.	WET $\bar{X}_w$**	WET B.P.E.
Dt 30.8W	55	876	31	480
Dt 25.7	482	1,690	40	6,710
Dt 20.6	537	6,400	27,500	311,000
Dt 19.0*	2,800	34,000	702,000	7,670,000
Dt 17.4W	3,140	46,200	12,700	210,000
Dt 14.6W	3,360	56,100	16,800	275,000
Dt 12.0W	6,990	34,400	8,530	41,400
Dt 9.6W*	2,430	11,700	10,100	50,400
Dt 9.3E	3,690	11,100	3,300	17,200
Dt 8.7W	5,340	26,500	18,400	90,800
Dt 3.9	5,150	57,100	14,400	141,000

* Results from 1963 data
** Mean adjusted to flow at cross-section

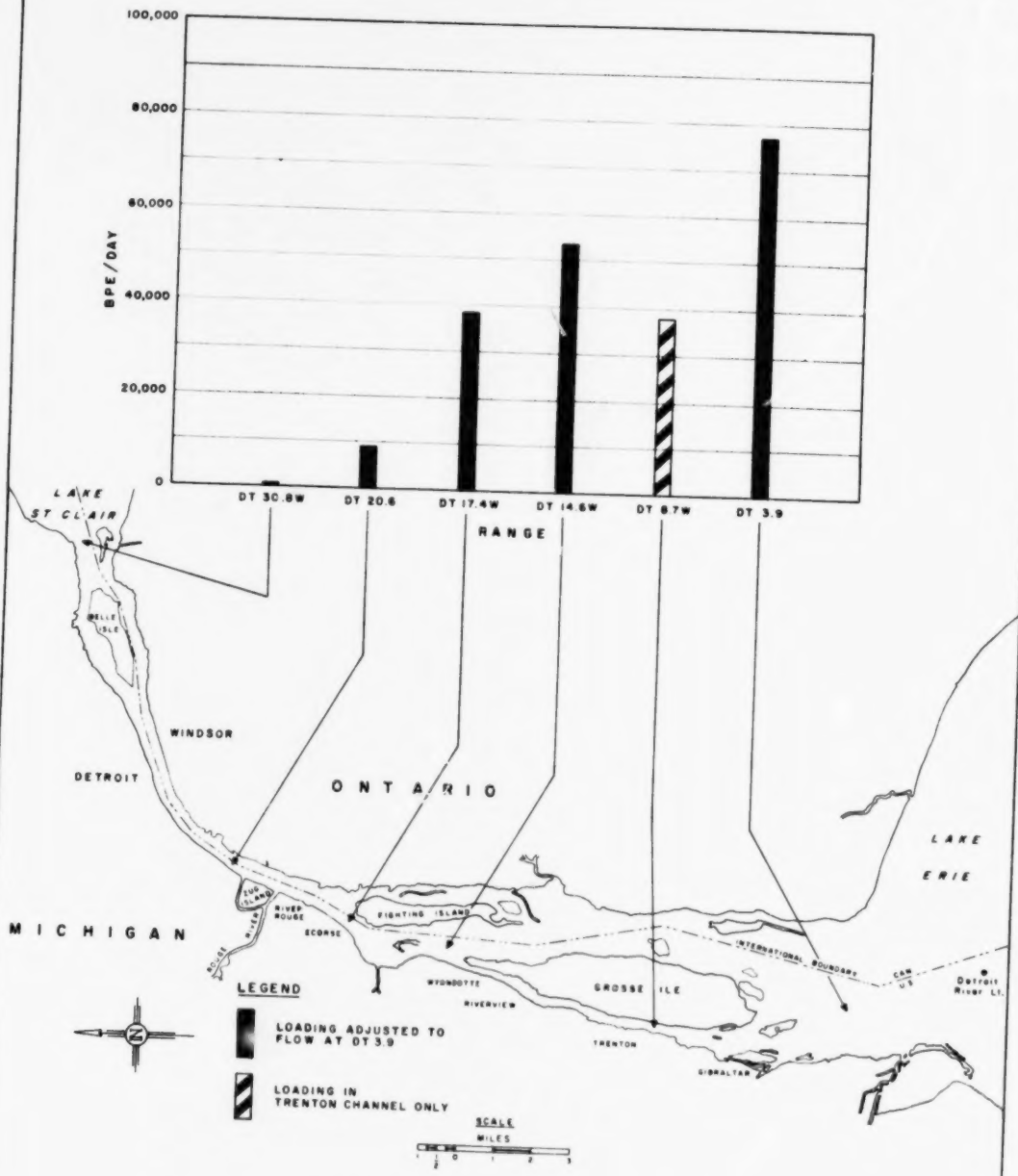
TABLE 42-V. SUMMARY OF DETROIT RIVER TRIBUTARY STREAM LOADINGS AND WEIGHTED AVERAGE CONCENTRATIONS

Tributary	Chlorides	Phenols[b]	Total Coliforms[a]	Phosphates	Nitrates	Ammonia Nitrogen	Organic Nitrogen	Total Nitrogen
Rouge River								
Weighted Avg. - mg/l	59	15	47,000	0.228	0.50	0.75	0.18	1.43
Loading - lbs/day	1,160,000	250	20,000	4,240	9,320	14,320	3,380	27,020
Ecorse River								
Weighted Avg. - mg/l	142	7.6	154,000	0.11	-	1.21	0.34	-
Loading - lbs/day	42,000	2.5	193	0.6	-	9.5	2.1	-
Monguagon Creek								
Weighted Avg. - mg/l	360	1,494	700	0.128	-	3.03	0.62	-
Loading - lbs/day	24,600	102	1.1	8.3	-	195	39	-

a - Weighted average in organisms per 100 ml and loading in BPE/day.

b - Phenol concentrations are in μg/l

FIGURE 29-V



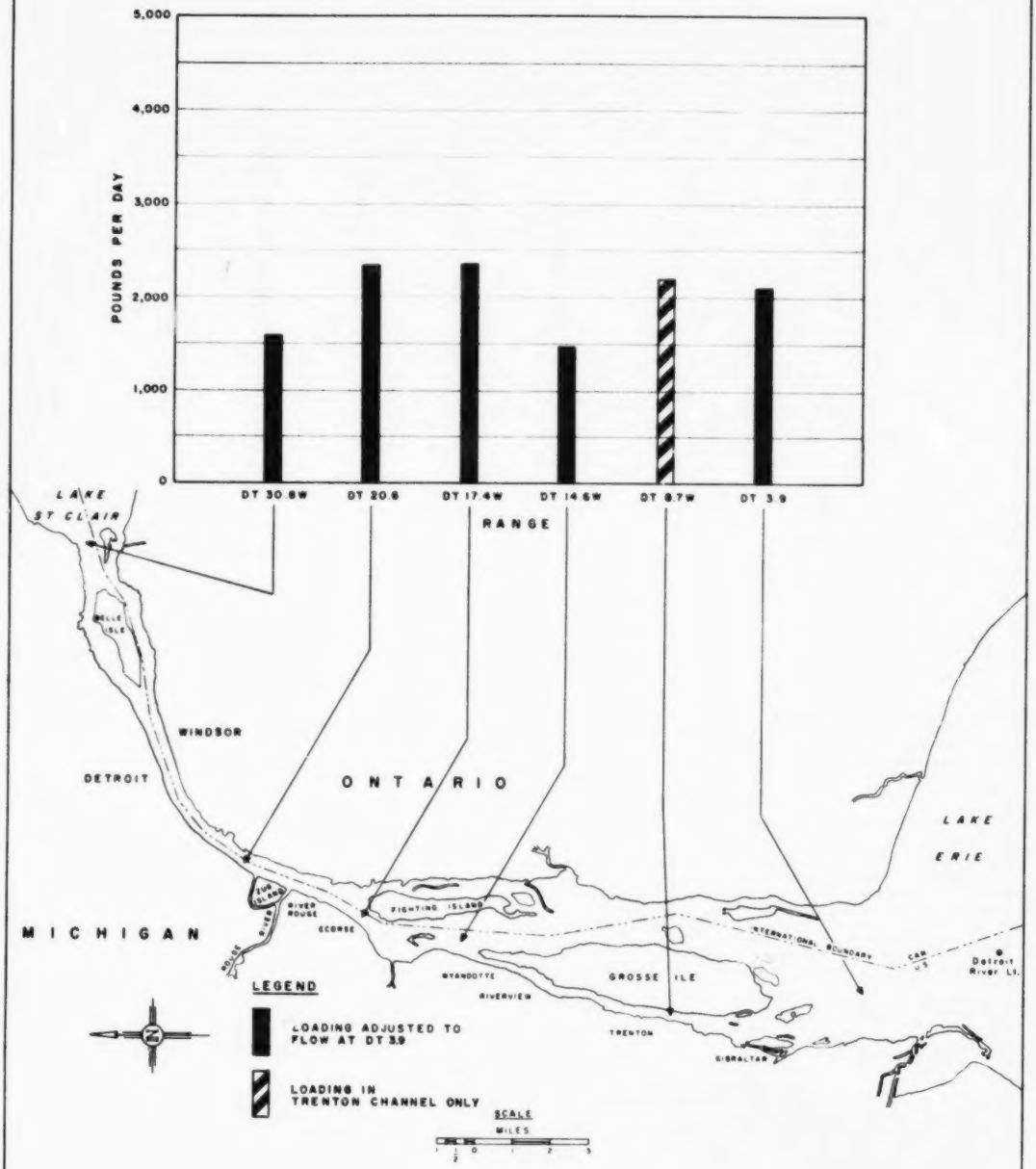
DETROIT RIVER-LAKE ERIE PROJECT

AVERAGE DAILY STREAM LOADINGS
COLIFORM ORGANISMS

U.S. WATERS
DETROIT RIVER

U.S. DEPARTMENT OF HEALTH, EDUCATION, & WELFARE
PUBLIC HEALTH SERVICE
REGION V GROSSE ILE, MICHIGAN

FIGURE 30-X

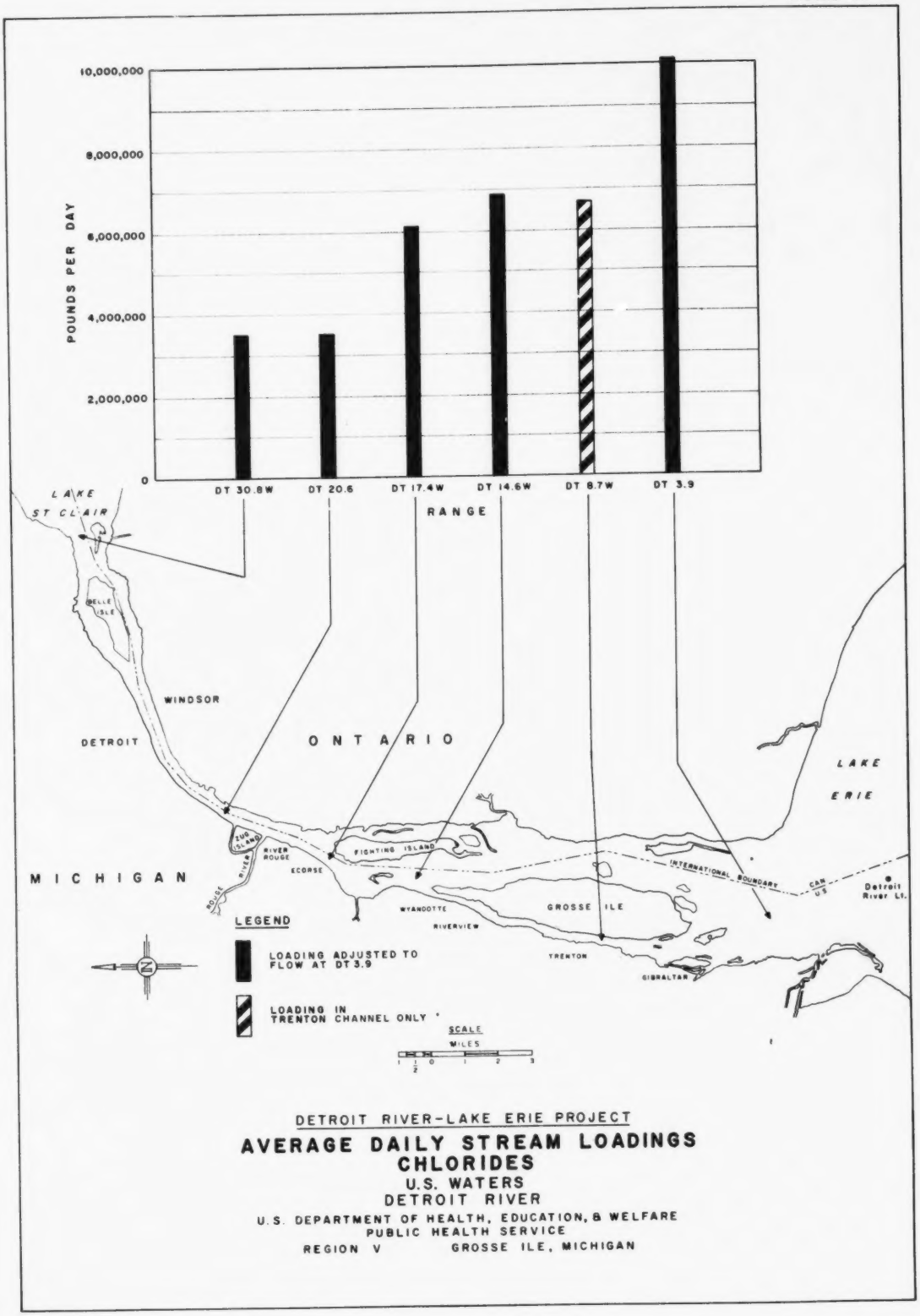


DETROIT RIVER-LAKE ERIE PROJECT

AVERAGE DAILY STREAM LOADINGS
PHENOLS
U.S. WATERS
DETROIT RIVER

U.S. DEPARTMENT OF HEALTH, EDUCATION, & WELFARE
PUBLIC HEALTH SERVICE
REGION V GROSSE ILE, MICHIGAN

FIGURE 31-V

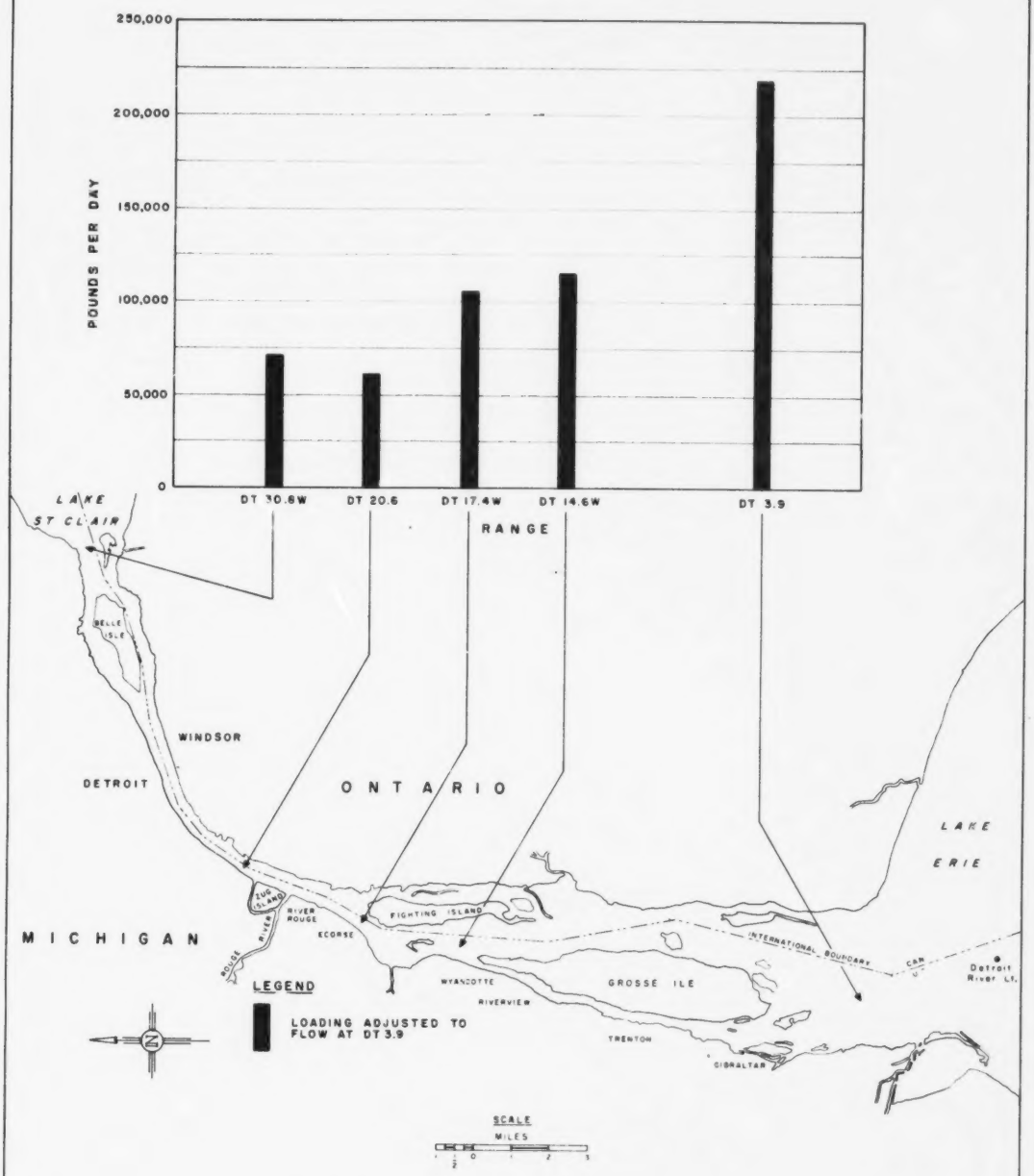


DETROIT RIVER-LAKE ERIE PROJECT

AVERAGE DAILY STREAM LOADINGS
CHLORIDES
U.S. WATERS
DETROIT RIVER

U.S. DEPARTMENT OF HEALTH, EDUCATION, & WELFARE
PUBLIC HEALTH SERVICE
REGION V GROSSE ILE, MICHIGAN

FIGURE 32-V



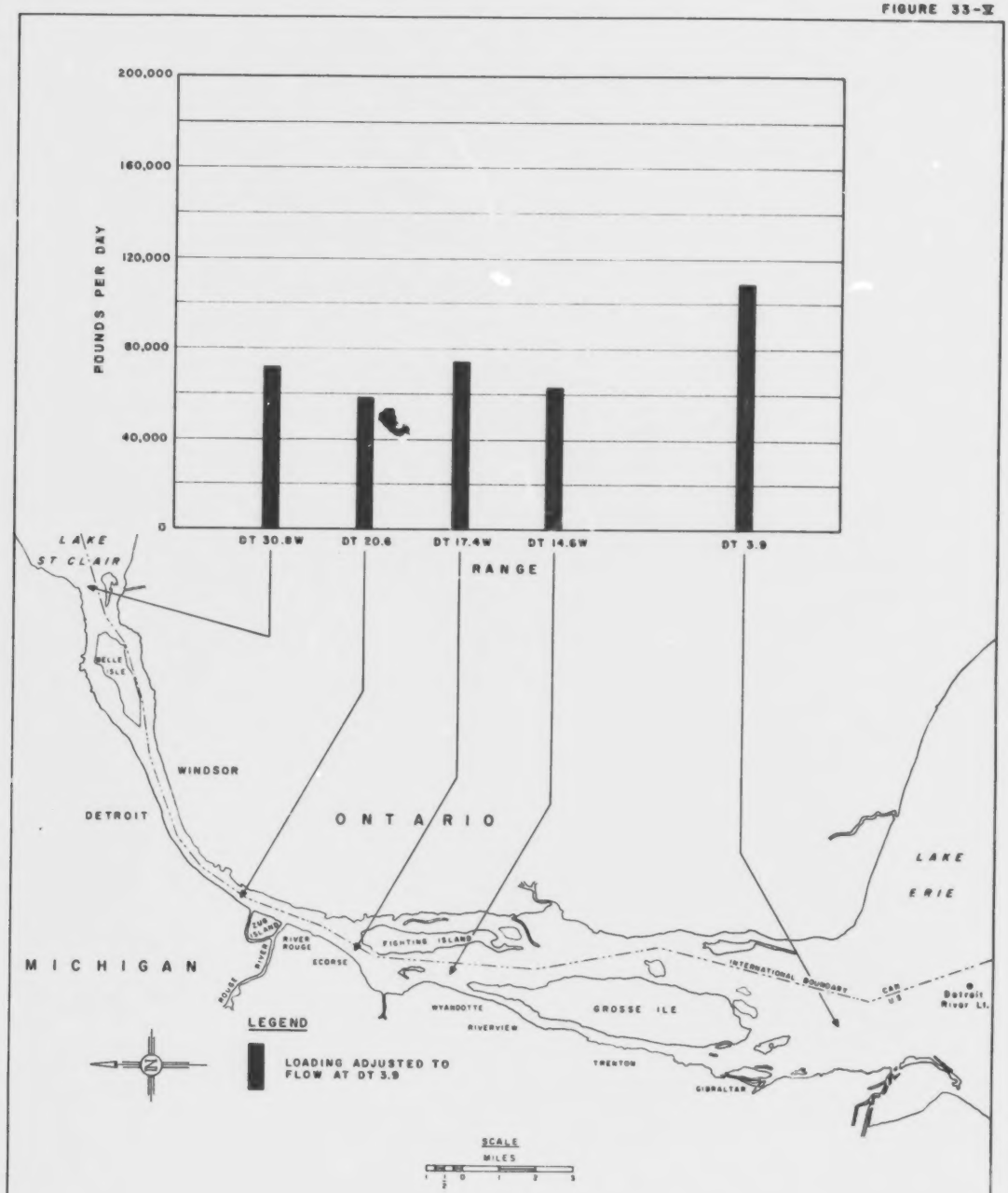
DETROIT RIVER-LAKE ERIE PROJECT

AVERAGE DAILY STREAM LOADINGS
PHOSPHATES (PO_4)

U.S. WATERS
DETROIT RIVER

U.S. DEPARTMENT OF HEALTH, EDUCATION, & WELFARE
PUBLIC HEALTH SERVICE
REGION V GROSSE ILE, MICHIGAN

FIGURE 33-V

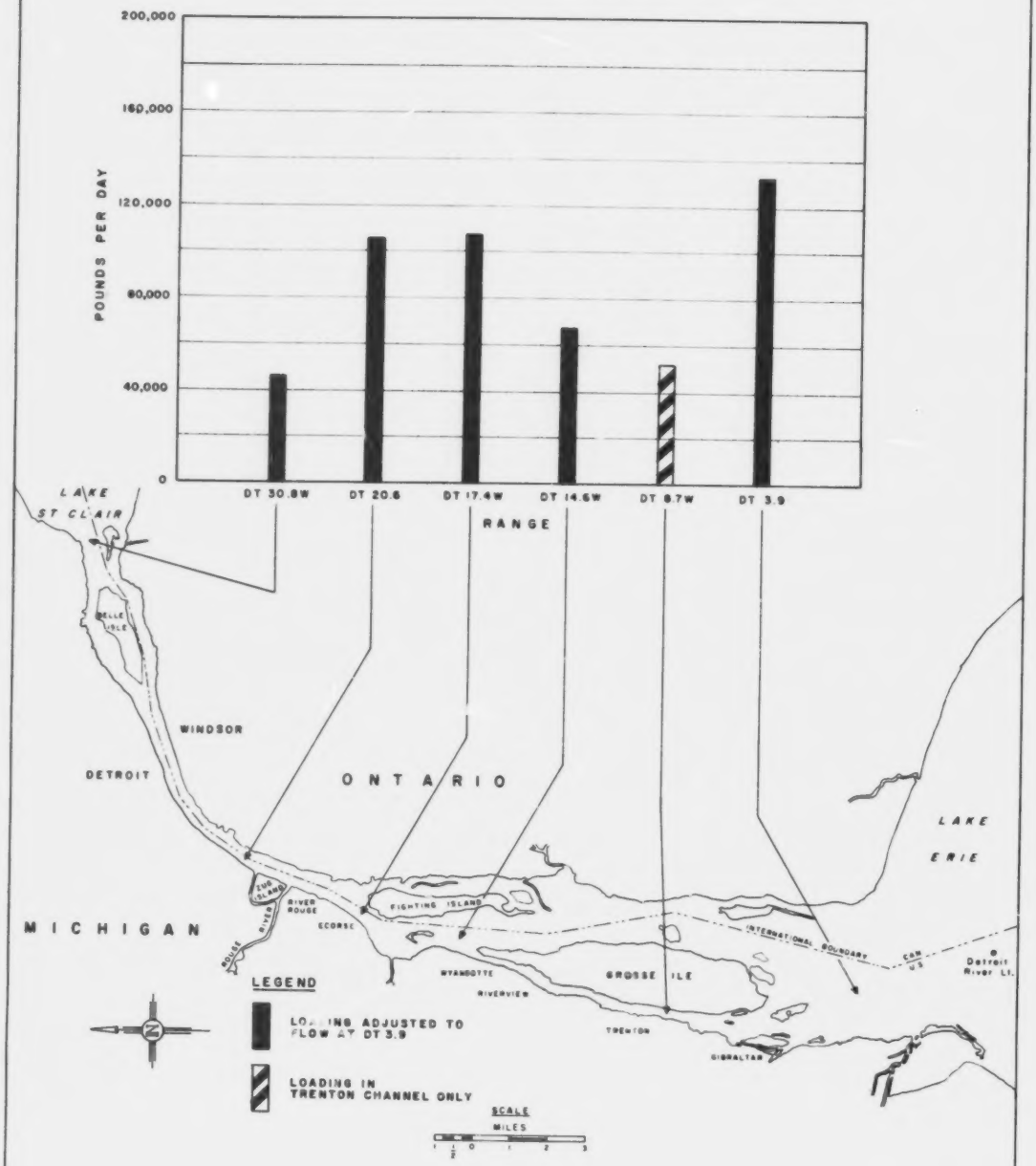


DETROIT RIVER-LAKE ERIE PROJECT

AVERAGE DAILY STREAM LOADINGS
NITRATES (N)
U.S. WATERS
DETROIT RIVER

U.S. DEPARTMENT OF HEALTH, EDUCATION, & WELFARE
PUBLIC HEALTH SERVICE
REGION V GROSSE ILE, MICHIGAN

FIGURE 34-V

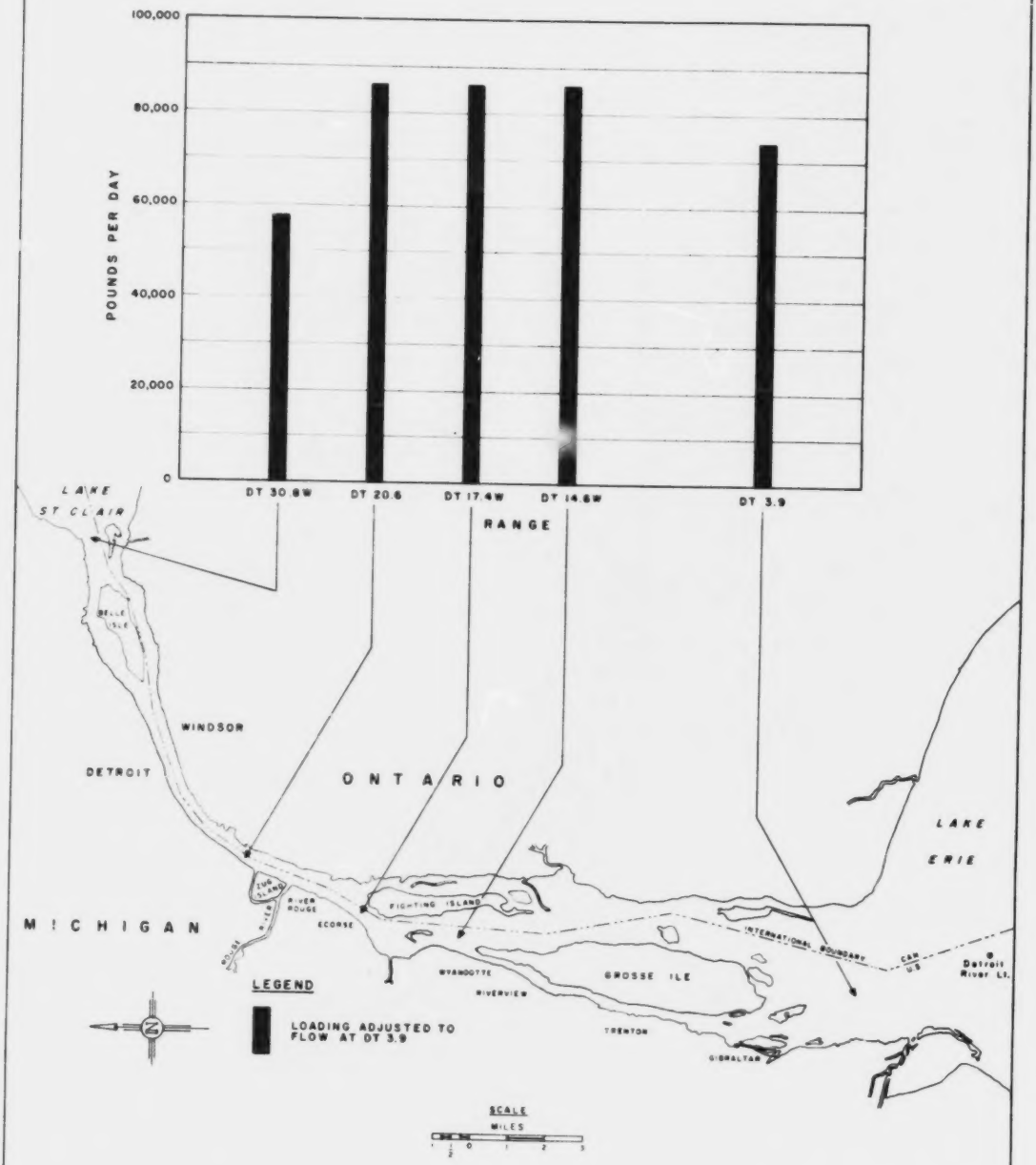


DETROIT RIVER-LAKE ERIE PROJECT

AVERAGE DAILY STREAM LOADINGS
AMMONIA (N)
U.S. WATERS
DETROIT RIVER

U.S. DEPARTMENT OF HEALTH, EDUCATION, & WELFARE
PUBLIC HEALTH SERVICE
REGION V GROSSE ILE, MICHIGAN

FIGURE 35-X

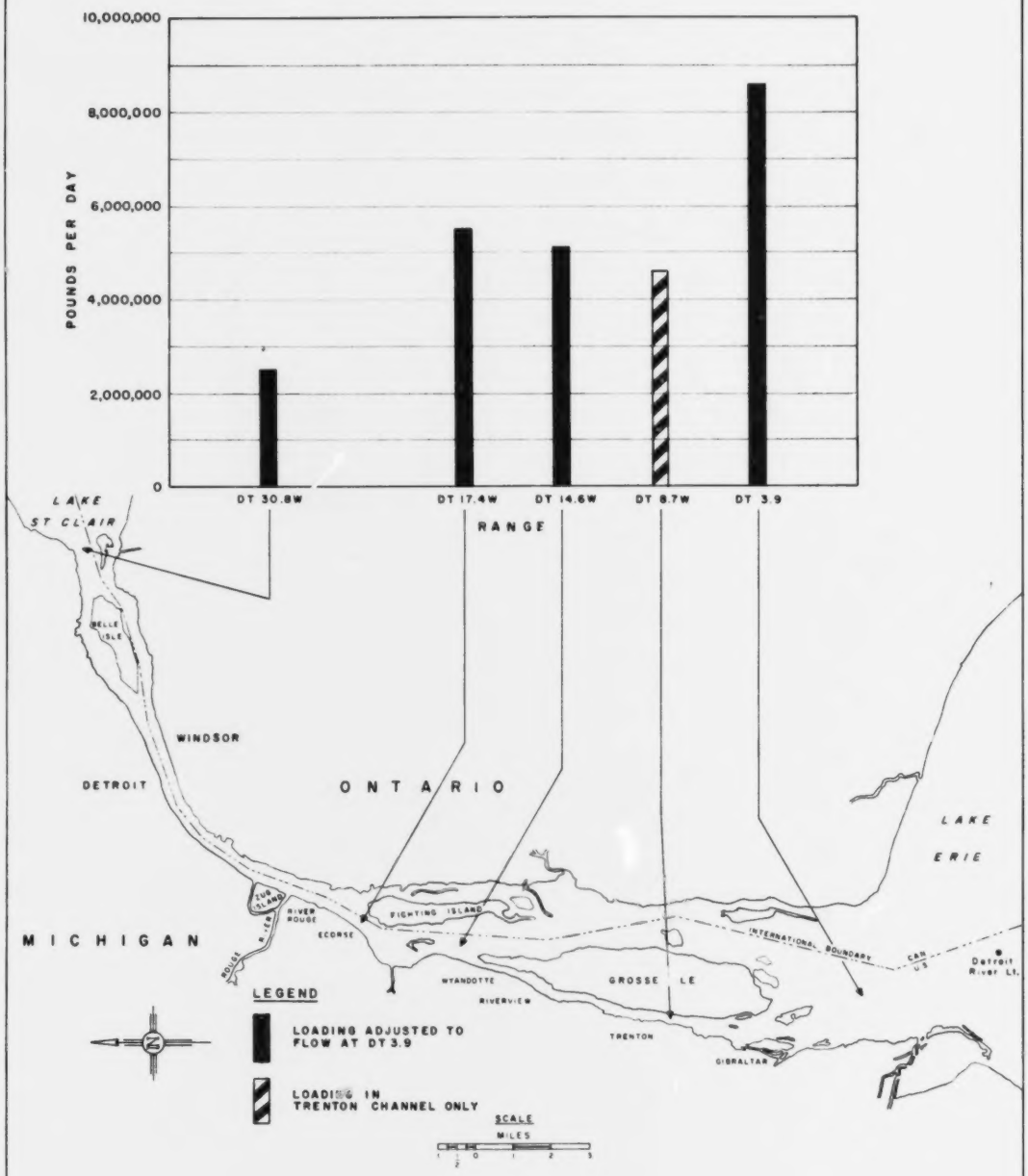


DETROIT RIVER-LAKE ERIE PROJECT

AVERAGE DAILY STREAM LOADINGS
ORGANIC NITROGEN
U.S. WATERS
DETROIT RIVER

U.S. DEPARTMENT OF HEALTH, EDUCATION, & WELFARE
PUBLIC HEALTH SERVICE
REGION V GROSSE ILE, MICHIGAN

FIGURE 36-V



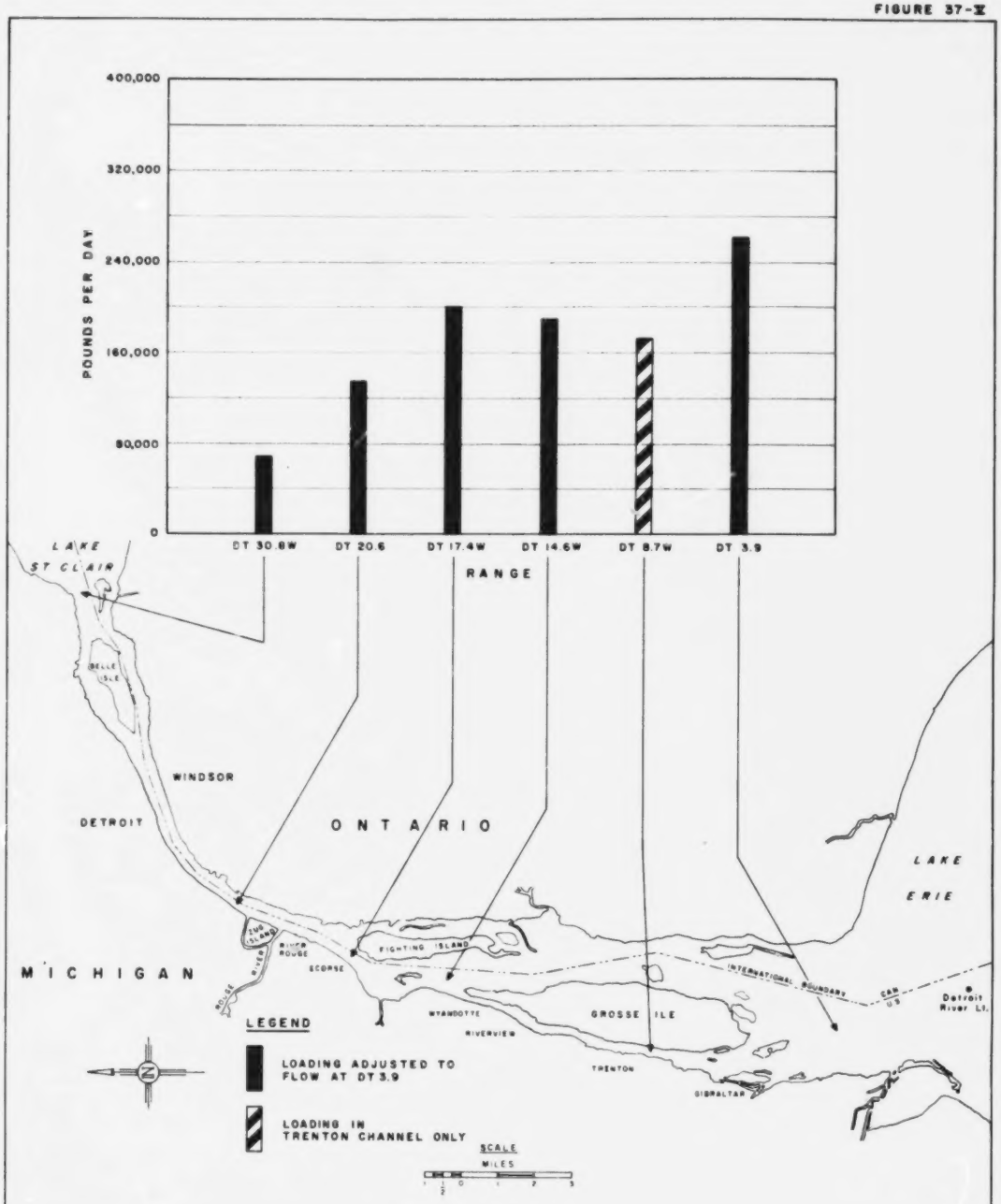
DETROIT RIVER-LAKE ERIE PROJECT

AVERAGE DAILY STREAM LOADINGS
SUSPENDED SOLIDS
U.S. WATERS
DETROIT RIVER

U.S. DEPARTMENT OF HEALTH, EDUCATION, & WELFARE
PUBLIC HEALTH SERVICE
REGION V GROSSE ILE, MICHIGAN

770-026 O-65-17

FIGURE 37-X



DETROIT RIVER-LAKE ERIE PROJECT

AVERAGE DAILY STREAM LOADINGS

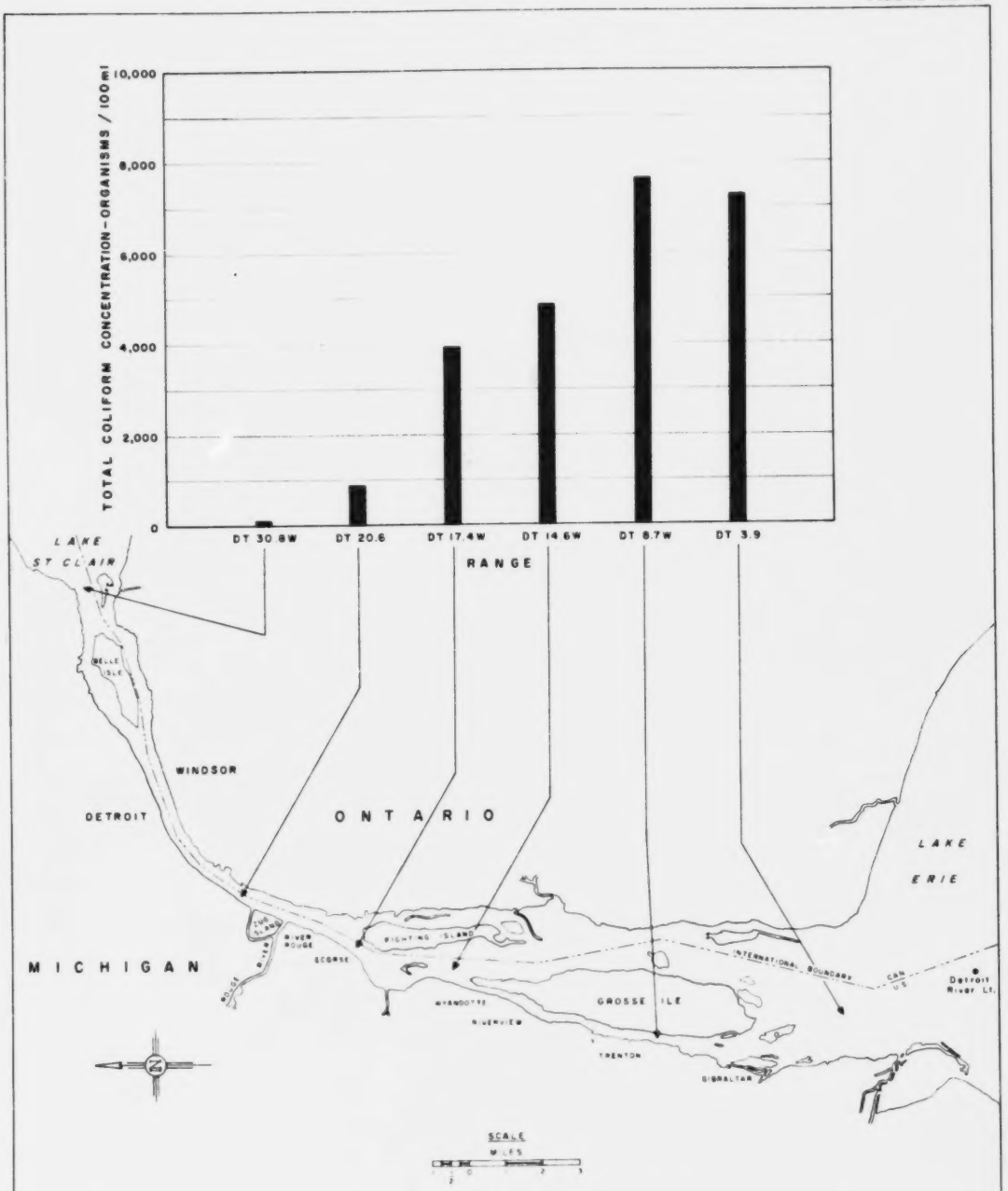
IRON

U.S. WATERS

DETROIT RIVER

U.S. DEPARTMENT OF HEALTH, EDUCATION, & WELFARE
PUBLIC HEALTH SERVICE
REGION V GROSSE ILE, MICHIGAN

FIGURE 38-V



DETROIT RIVER-LAKE ERIE PROJECT

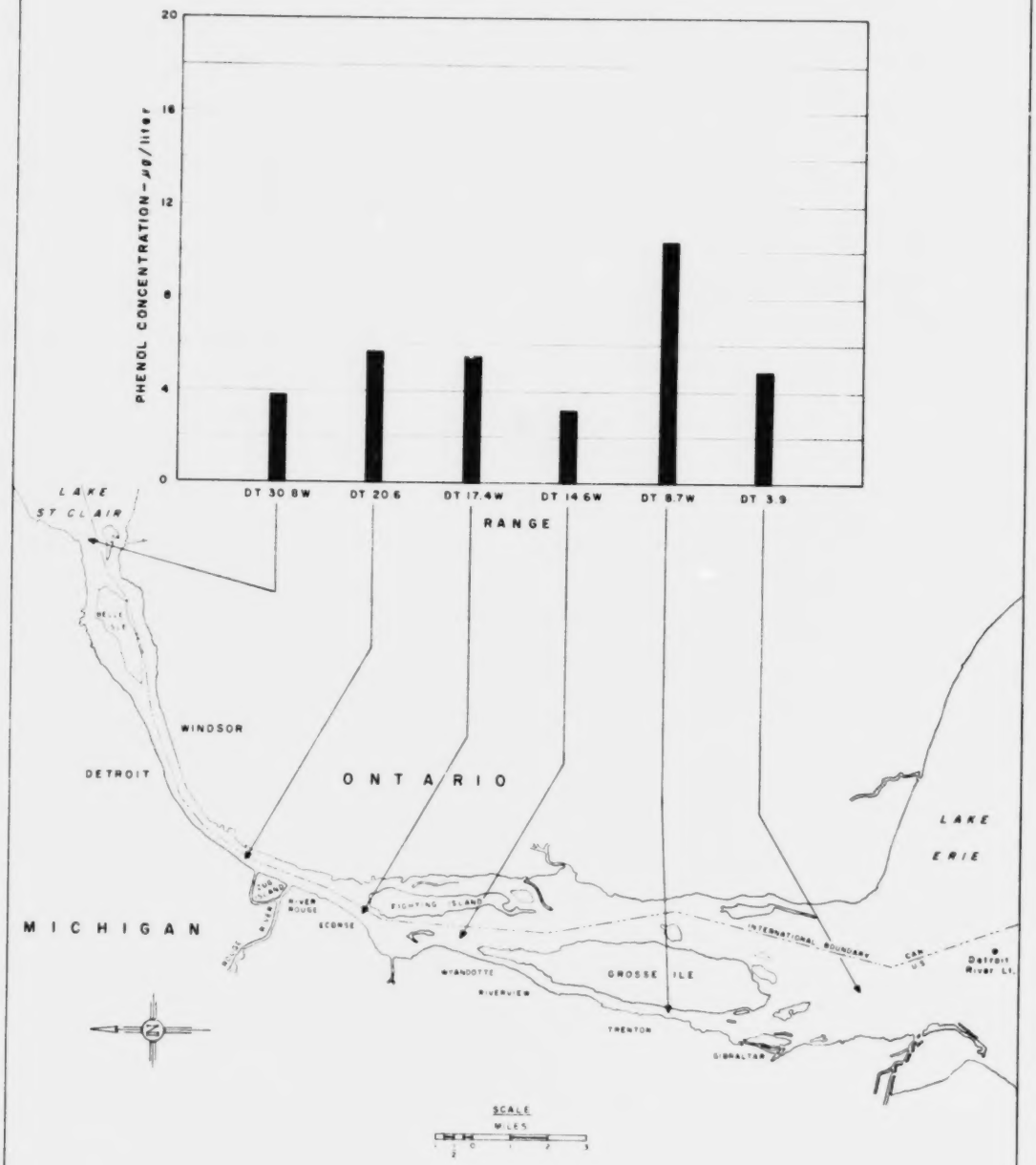
GEOMETRIC MEAN COLIFORM CONCENTRATIONS ADJUSTED TO FLOW AT CROSS-SECTION

U.S. WATERS

DETROIT RIVER

U.S. DEPARTMENT OF HEALTH, EDUCATION, & WELFARE
PUBLIC HEALTH SERVICE
REGION V GROSSE ILE, MICHIGAN

FIGURE 39-V



DETROIT RIVER-LAKE ERIE PROJECT

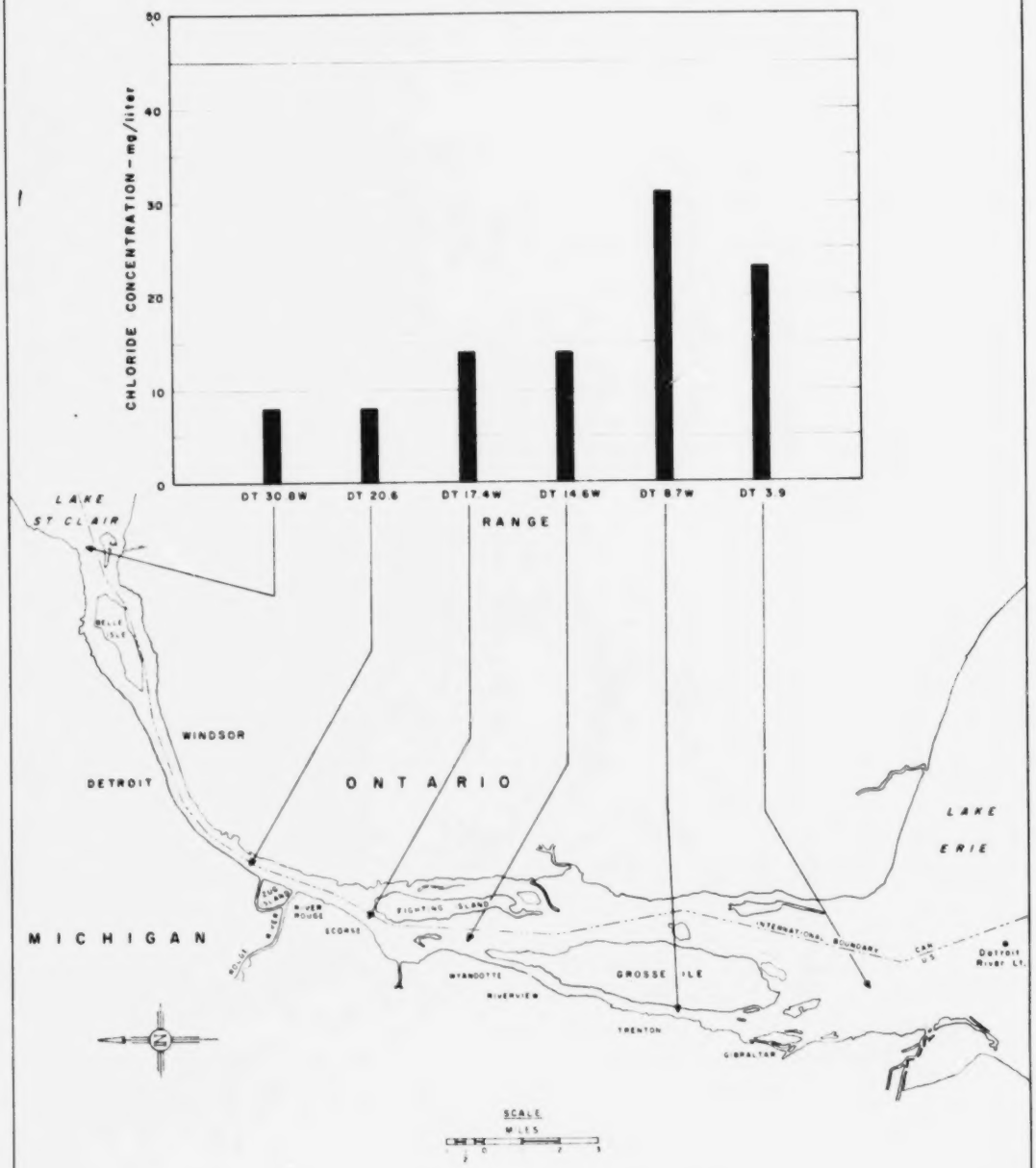
AVERAGE PHENOL CONCENTRATIONS ADJUSTED TO FLOW AT CROSS-SECTION

U.S. WATERS

DETROIT RIVER

U.S. DEPARTMENT OF HEALTH, EDUCATION, & WELFARE
PUBLIC HEALTH SERVICE
REGION V GROSSE ILE, MICHIGAN

FIGURE 40-V



DETROIT RIVER-LAKE ERIE PROJECT

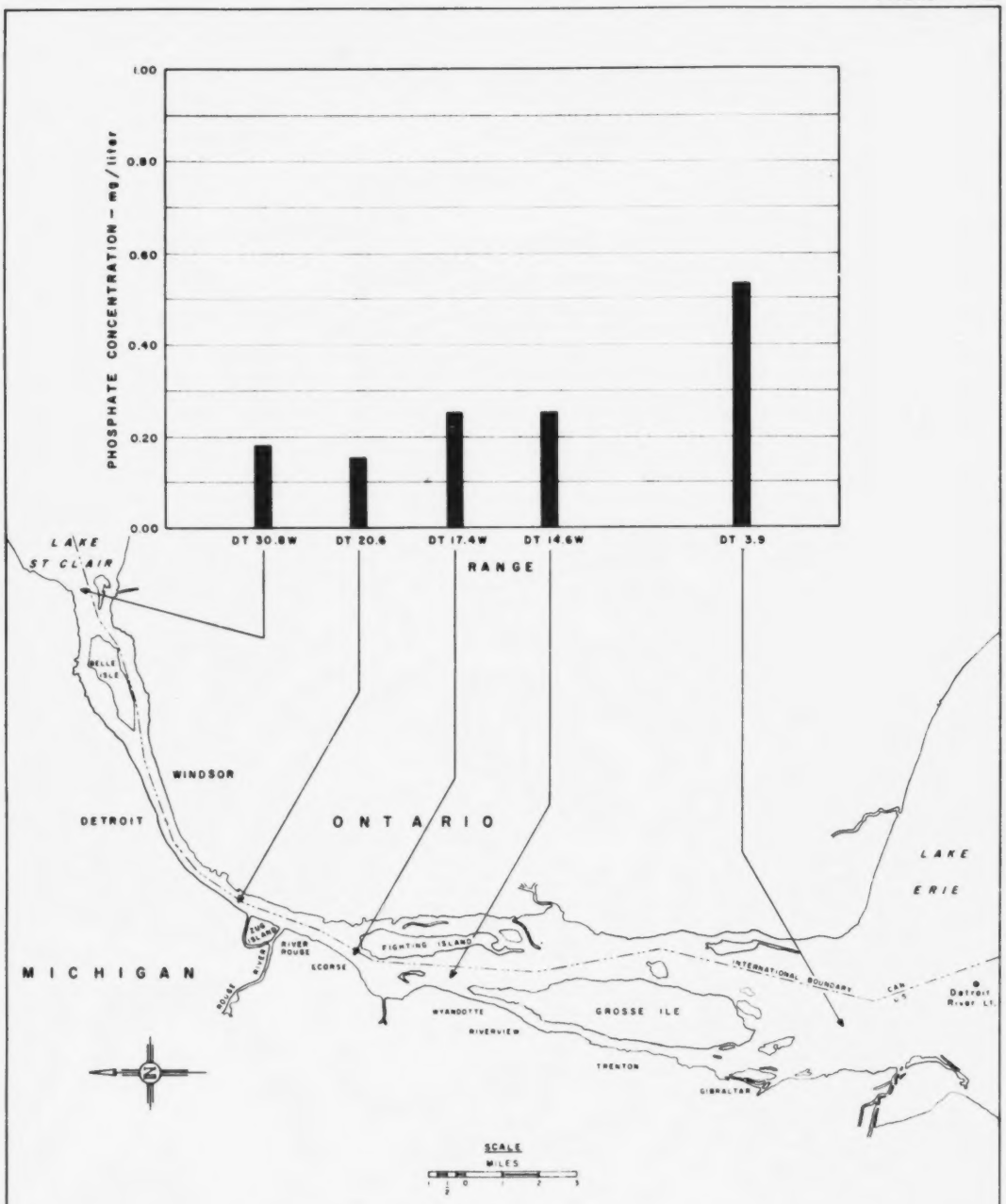
AVERAGE CHLORIDE CONCENTRATIONS ADJUSTED TO FLOW AT CROSS-SECTION

U.S. WATERS

DETROIT RIVER

U S DEPARTMENT OF HEALTH, EDUCATION, & WELFARE
PUBLIC HEALTH SERVICE
REGION V GROSSE ILE, MICHIGAN

FIGURE 41-V



DETROIT RIVER-LAKE ERIE PROJECT

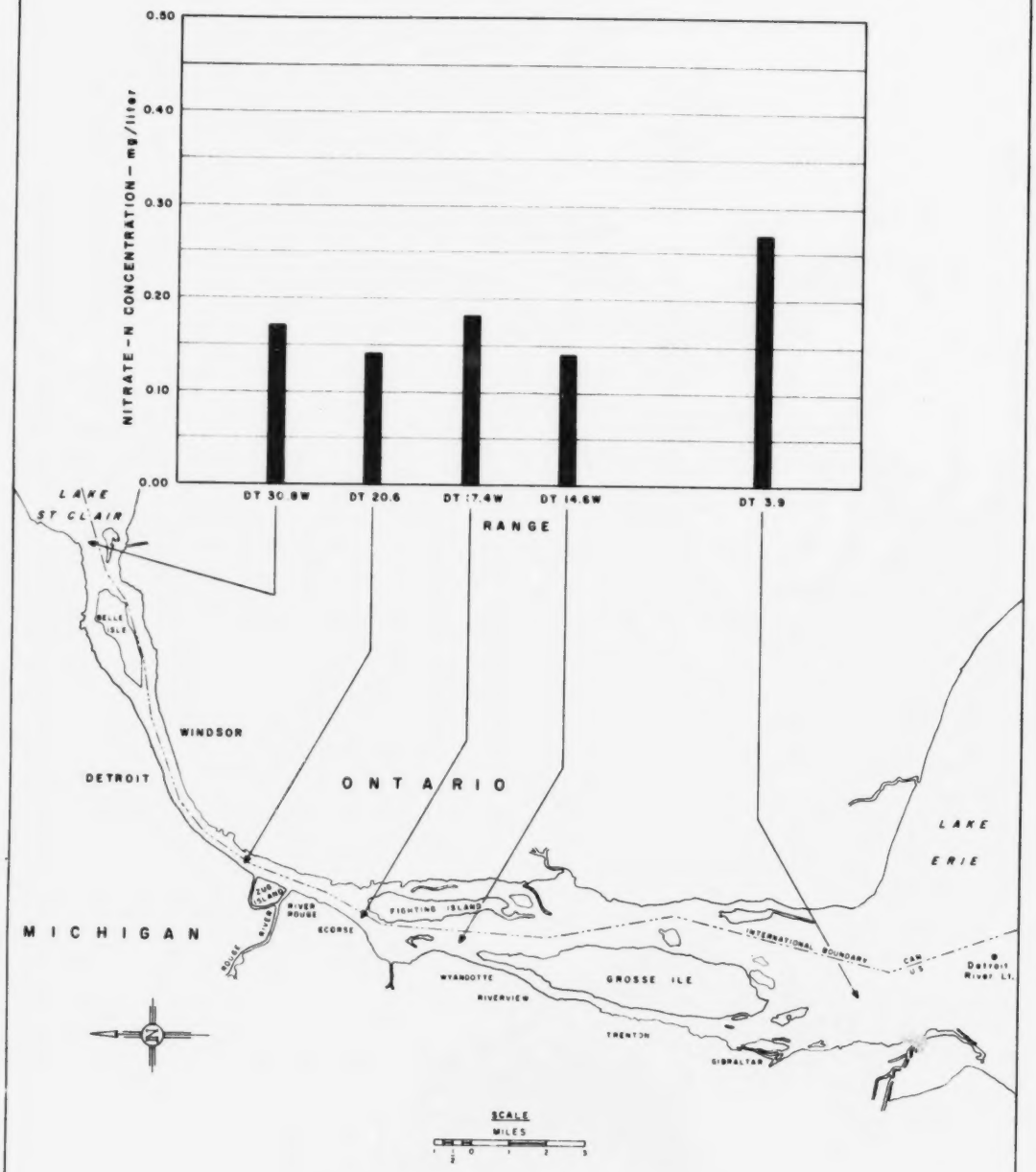
AVERAGE PHOSPHATE CONCENTRATIONS ADJUSTED TO FLOW AT CROSS-SECTION

U.S. WATERS

DETROIT RIVER

U.S. DEPARTMENT OF HEALTH, EDUCATION, & WELFARE
PUBLIC HEALTH SERVICE
REGION V GROSSE ILE, MICHIGAN

FIGURE 42-X



DETROIT RIVER-LAKE ERIE PROJECT

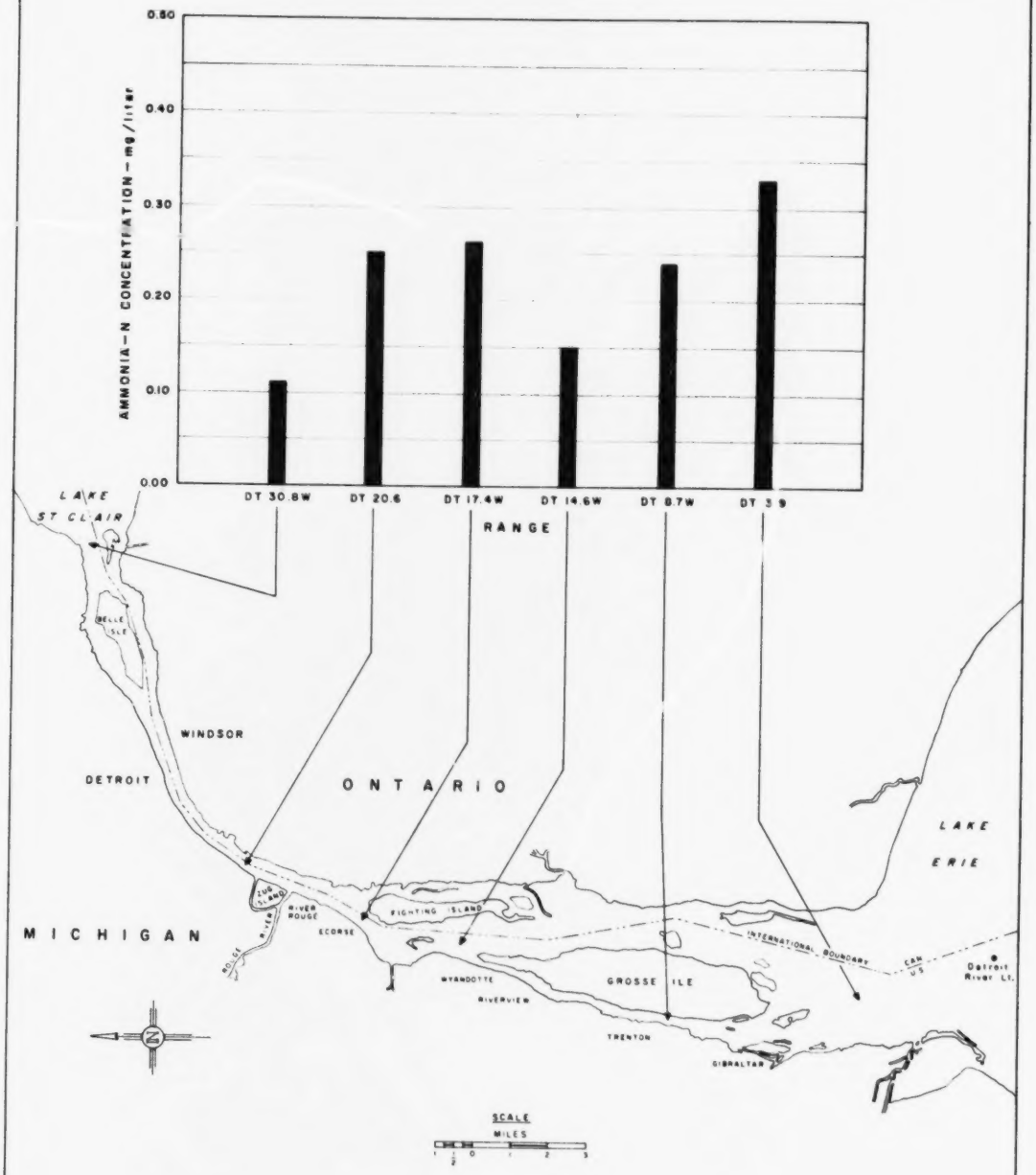
AVERAGE NITRATE-N CONCENTRATIONS ADJUSTED TO FLOW AT CROSS-SECTION

U.S. WATERS

DETROIT RIVER

U.S. DEPARTMENT OF HEALTH, EDUCATION, & WELFARE
PUBLIC HEALTH SERVICE
REGION V GROSSE ILE, MICHIGAN

FIGURE 43-X



DETROIT RIVER-LAKE ERIE PROJECT

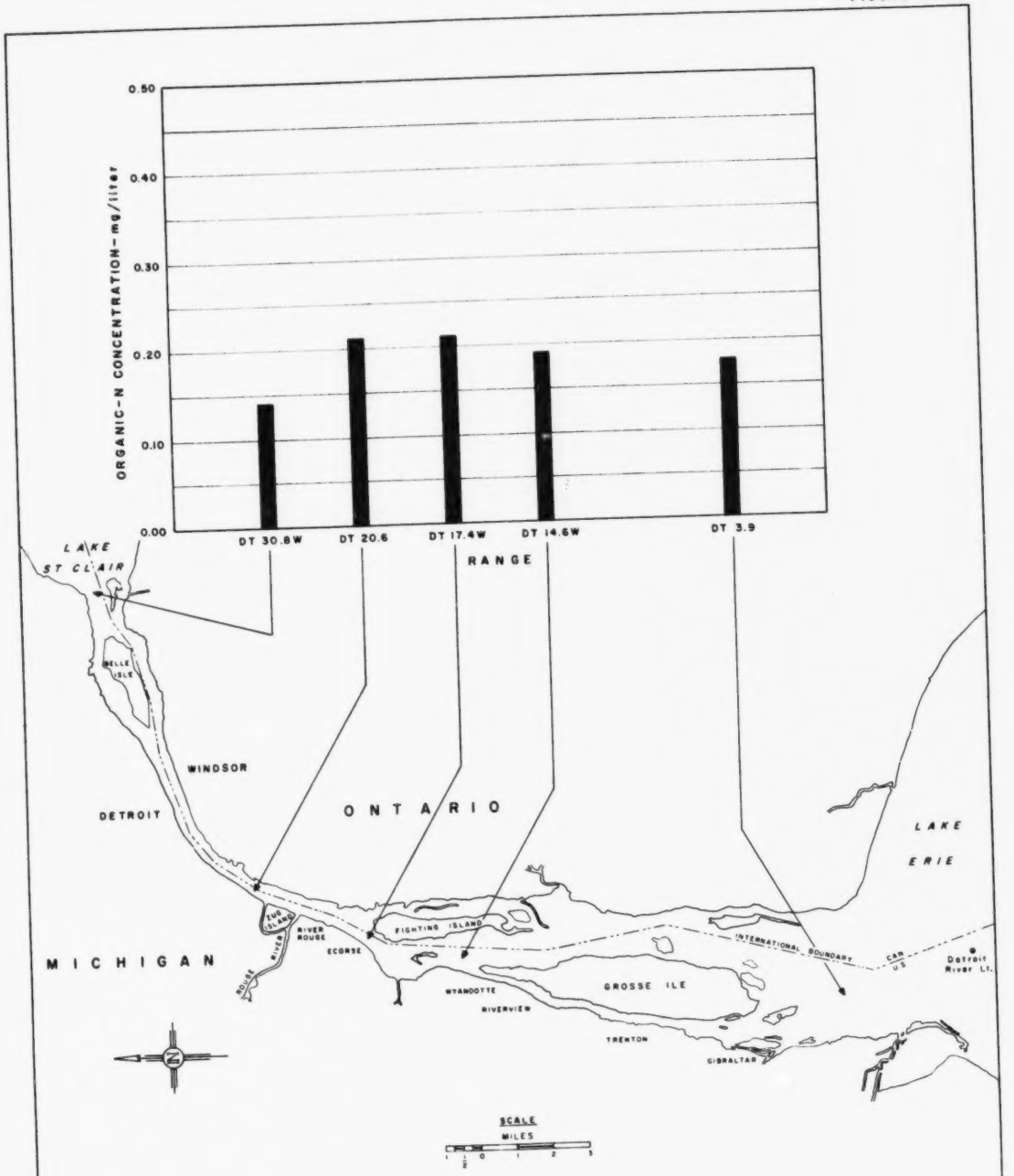
AVERAGE AMMONIA-N CONCENTRATIONS ADJUSTED TO FLOW AT CROSS-SECTION

U.S. WATERS

DETROIT RIVER

U.S. DEPARTMENT OF HEALTH, EDUCATION, & WELFARE
PUBLIC HEALTH SERVICE
REGION V GROSSE ILE, MICHIGAN

FIGURE 44-V



DETROIT RIVER-LAKE ERIE PROJECT

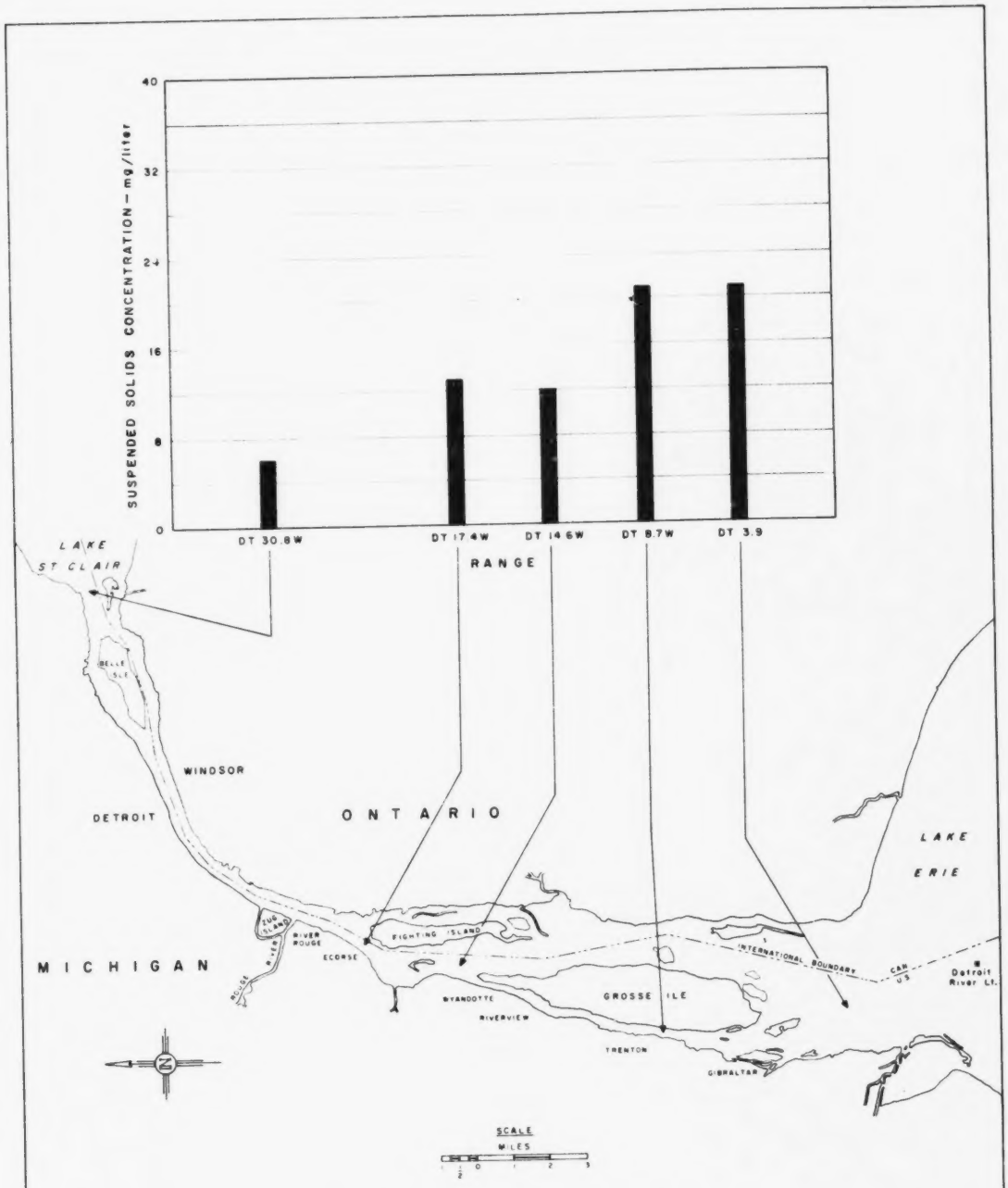
AVERAGE ORGANIC-N CONCENTRATIONS ADJUSTED TO FLOW AT CROSS-SECTION

U.S. WATERS

DETROIT RIVER

U.S. DEPARTMENT OF HEALTH, EDUCATION, & WELFARE
PUBLIC HEALTH SERVICE
REGION V GROSSE ILE, MICHIGAN

FIGURE 45-X



DETROIT RIVER-LAKE ERIE PROJECT

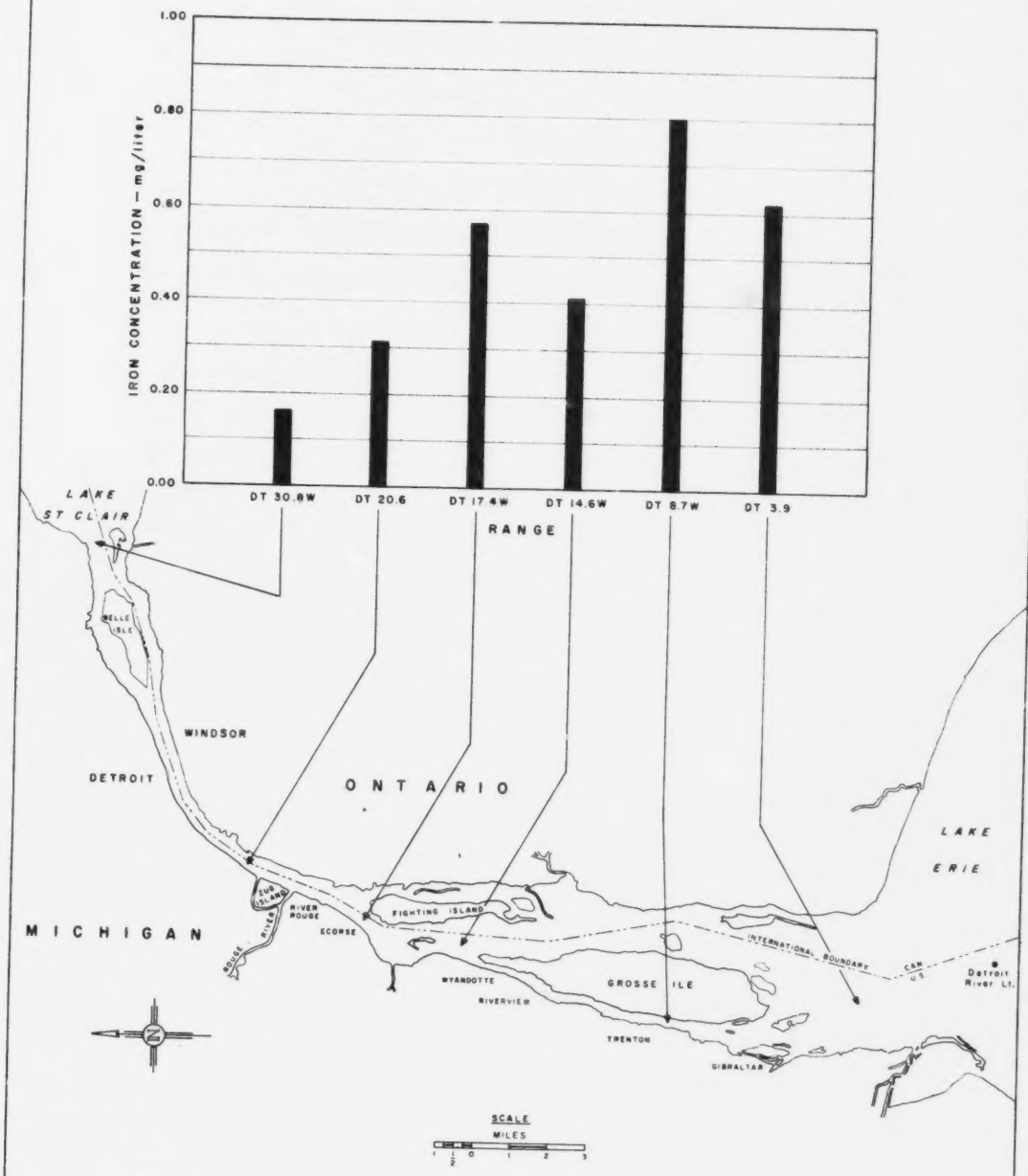
AVERAGE SUSPENDED SOLIDS CONCENTRATIONS ADJUSTED TO FLOW AT CROSS-SECTION

U.S. WATERS

DETROIT RIVER

U.S. DEPARTMENT OF HEALTH, EDUCATION, & WELFARE
PUBLIC HEALTH SERVICE
REGION V GROSSE ILE, MICHIGAN

FIGURE 46-V



DETROIT RIVER-LAKE ERIE PROJECT

AVERAGE IRON CONCENTRATIONS ADJUSTED TO FLOW AT CROSS-SECTION

U.S. WATERS

DETROIT RIVER

U.S. DEPARTMENT OF HEALTH, EDUCATION, & WELFARE
PUBLIC HEALTH SERVICE
REGION V GROSSE ILE, MICHIGAN

Intensive Surveys

Intensive surveys were made of the Detroit River to detect any major change in water quality during the day or night and determine if weekend conditions approximated those found during the week. Surveys of the Rouge River, Ecorse Creek, and Monguagon Creek were also made to detect changes in water quality in these waters upstream from the regular sampling station.

Detroit River

Two intensive surveys were conducted on the Detroit River, each lasting 10 consecutive days with composite and individual sampling at specified intervals. One survey was conducted during dry conditions and one during wet conditions. No diurnal variation was noted in the water quality of the river and no significant difference between weekend and weekday water quality was observed.

Generally speaking, the results from this survey were comparable with summer results of the regular sampling program.

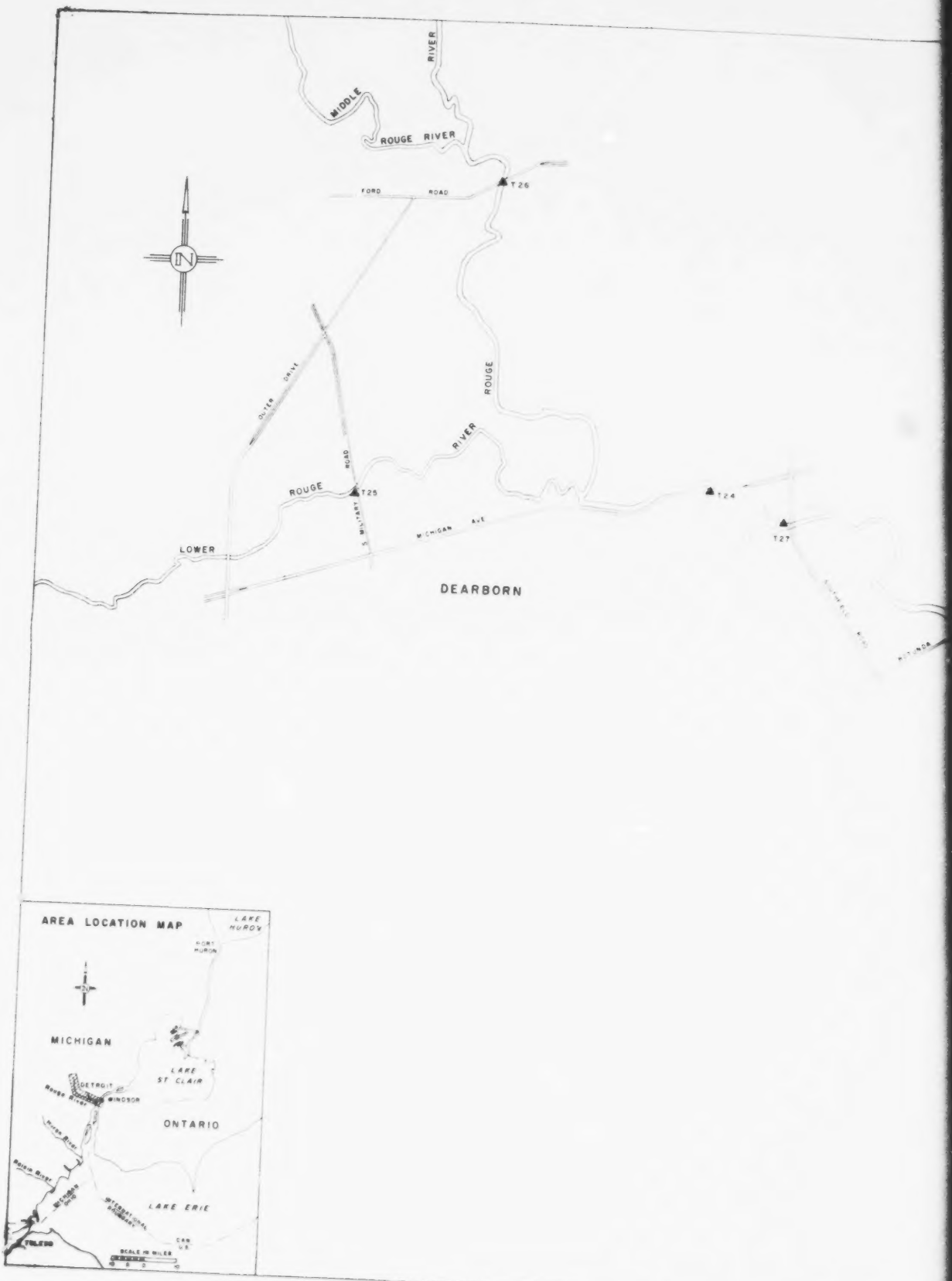
Rouge River

Three surveys were made of the Rouge River during Calendar Year 1963. Figure 50-V shows the location of the sampling points surveyed. River flow during these surveys remained comparatively constant, presumably because of a constant industrial waste discharge of significant quantity compared with natural stream discharge. Table 47-V summarizes results during the first survey conducted during the winter of 1963. Correspondence from the Michigan Department of Health revealed that during the survey raw sewage was bypassed while a recently completed interceptor from the City of Dearborn was inspected and cleaned. Table 48-V and 49-V summarize the results of the second and third Rouge River Surveys. During the third survey only bacteriological evaluations were made.

Phenol concentrations averaged 98 $\mu g/l$ during the first survey at a point 1.8 miles upstream from the mouth and decreased noticeably to a range of 2 - 22 $\mu g/l$, due primarily to dilution with Detroit River water from the old channel of the Rouge River. During the summer survey (No. 2) phenol values were much lower than the winter, ranging from 2.5 to 8.7 $\mu g/l$.

Coliform densities at the mouth averaged 490 organisms per 100 ml during survey number 1 but increased to exceptionally high values in the upper reaches of this tributary, with geometric mean values exceeding 34 million per 100 ml. No doubt the occasional bypass of raw sewage by the City of Dearborn described by the Michigan Department of Health accounted for a great deal of these high values. During the second survey conducted during the summer of 1963, the geometric mean coliform density at the mouth was 40,000 per 100 ml and decreased at upstream stations. During survey number 3, coliform densities were typified by sudden increases at two locations in the River.

During this survey a significant increase was found in the Rouge River coliform densities between Greenfield and Schaefer Roads (3,300 to 90,000 per 100 ml). Investigation showed this increase was due to discharge of highly concentrated bacterial wastes from a rendering plant operated by Darling and Company. The sudden increase (3,200 to 56,000 per 100 ml) in bacterial densities at the mouth of the Rouge was attributable to the sporadic discharge of raw sewage into the River from an overloaded pumping station operated by the City of River Rouge. This information was turned over to appropriate State of Michigan agencies, and in both cases corrective action was taken to eliminate these sources of pollution.


MIDDLE
RIVER
ROUGE RIVER
FORD ROAD
T26
OUTER DRIVE
ROUGE
RIVER
ROUGE
T25
S MILITARY ROAD
MICHIGAN AVE
LOWER
T24
T27
DEARBORN
AREA LOCATION MAP
LAKE HURON
PORT HURON
MICHIGAN
LAKE ST CLAIR
DETROIT
WINDSOR
ONTARIO
LAKE ERIE
TOLEDO
SCALE IN MILES

261 a

MICHIGAN

RIVER ROUGE

261 b

FIGURE 50-V

DETROIT RIVER—LAKE ERIE PROJECT

LOCATION OF SAMPLING STATIONS

ROUGE RIVER

U.S. DEPARTMENT OF HEALTH, EDUCATION, AND WELFARE
PUBLIC HEALTH SERVICE
REGION V GROSSE ILE, MICHIGAN

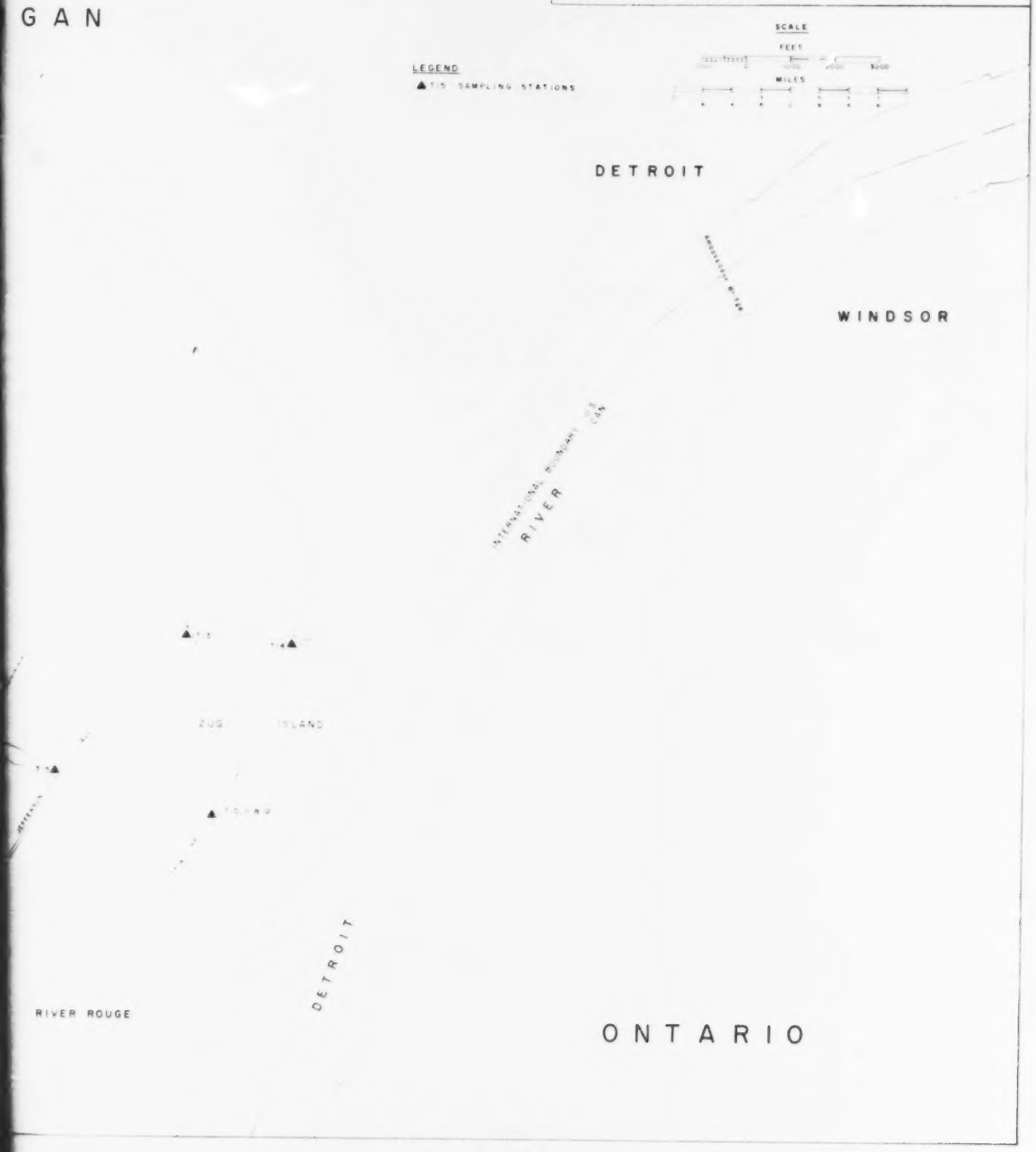


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TABLE 47-V. SUMMARY OF RESULTS OF
INTENSIVE ROUGE RIVER SURVEY NUMBER ONE*

January 14-31, 1963

Unit	Station / Constituent	T11	T13	T14	T15	T16	T17	T18	T19	T20	T21	T24	T25
organisms/100 ml	Total Coliform	400	267	216	1,000	2,300	3,200	3,000	8,900	110,000	90,000	1,000,000	3,430,000
organisms/100 ml	Fecal Coliform	100	53	56	670	1,100	2,100	1,400	3,600	67,000	-	400,000	1,400,000
organisms/100 ml	Fecal Strep.	34	21	29	133	173	200	263	340	10,600	48,000	42,000	136,000
µg/l	Phenols	22	8	2	79	73	98	87	50	28	-	20	41
mg/l	Iron	1.39	.23	.31	.43	.59	.41	.35	.35	.48	-	.75	.82
mg/l	Suspended Solids	4	3	3	20	25	24	29	31	14	0	16	55
mg/l	ABS	.50	.12	.12	.21	.21	.22	.22	.31	.66	-	4.54	6.14
-	pH	7.7	7.8	7.6	7.1	7.1	7.1	7.0	6.9	7.5	-	7.6	7.4
mg/l	Chlorides	34	13	13	40	40	41	41	42	86	296	185	152
°C	Temperature	0.5	0.3	0.2	5.3	5.2	5.4	5.7	5.9	6.1	-	0.3	3.7

* Average values found during survey for all constituents except bacteria for which geometric means are shown.

mg/l	Dissolved Oxygen	13.8	13.7	14.1	9.5	9.8	10.3	10.3	9.3	9.0	6.2	-	1.7
µmhos x 4	Conductivity	75	53	46	85	93	97	94	98	151	330	338	303
mg/l	BOD	4.2	2.1	1.9	2.8	3.5	3.0	3.6	5.3	11.1	-	36.4	103.3
mg/l	Copper	.01	.01	.04	.01	<.01	.01	.01	<.01	.01	-	.14	.78
mg/l	Cadmium	<.01	<.01	<.01	<.01	<.01	<.01	<.01	<.01	<.01	-	.05	<.01
mg/l	Nickel	.01	.01	.03	.02	.01	.01	.01	.01	.04	-	.02	.29
mg/l	Zinc	.02	.02	.02	.09	.09	.11	.10	.09	.05	-	.05	.09
mg/l	Lead	.02	.01	.03	.01	.01	.01	.01	.01	.02	-	.02	.01
mg/l	Chromium	.01	.01	.01	.02	.02	.03	.02	.03	.02	-	.03	.08

TABLE 48-V. SUMMARY OF RESULTS OF INTENSIVE ROUGE RIVER SURVEY NUMBER TWO[a]

June 16-19, 1963

Unit	Constituent \ Station	T11	T13	T15	T16
Organisms/100 ml	Total Coliform	40,000	590	20,000	6,800
Organisms/100 ml	Fecal Coliform	13,000	230	5,500	2,500
Organisms/100 ml	Fecal Strep.	900	46	450	170
mg/l	BOD	5.1	2.5	3.3	13.2
mg/l	COD	28	7	18	15
µg/l	Phenols	3.7	8.7	2.7	2.5
	pH	7.2	8.0	7.2	7.2
°C	Temperature	20.1	17.8	20.5	22.0
mg/l	Chloride	65	22	42	33
mg/l	Ammonia	1.07	.42	.53	.63
mg/l	Org N	.26	.41	.29	.36
mg/l	Suspended Solids	13	0	14	16
mg/l	Settleable Solids	12	-	10	12
mg/l	Iron	2.06	-	2.21	-
mg/l	Cyanides	0	0	0	0
mg/l	ABS	.14	-	.11	-
mg/l	Copper	*	-	*	-
	Nickel	.01	-	.02	-
	Zinc	.01	-	*	-
	Lead	.02	-	*	-
	Chromium	.01	-	*	-
	Cadmium	*	-	*	-

* Not detected at the sensitivity of the test, .01 mg/l

\- No determination made

a Average values found during survey for all constituents except bacteria for which geometric means are shown.

TABLE 49-V. SUMMARY OF RESULTS OF
INTENSIVE ROUGE RIVER SURVEY NUMBER THREE

September 24 - October 1, 1963

	Geometric Mean Coliform Densities Org/100 ml	Maximum Coliform Densities Org/100 ml	Minimum Coliform Densities Org/100 ml
T10	55,000	440,000	5,000
T11	60,000	450,000	10,000
T12	54,000	450,000	10,000
T13	810	5,000	200
T14	770	4,800	120
T15	21,000	1,300,000	1,200
T16	3,200	17,000	800
T17	1,300	19,000	140
T18	1,100	8,000	20
T19	1,600	51,000	40
T20	90,000	2,100,000	5,000
T21	3,300	61,000	400
T22	4,100	53,000	300
T23	8,500	48,000	1,000
T24	3,900	24,000	1,000
T25	8,000	41,000	2,000
T26	6,100	360,000	2,000
T27	3,300	13,000	900

BOD and dissolved oxygen values during survey number 1 indicated that the oxygen-consuming wastes were also attributable to the bypass during construction repairs by the City of Dearborn.

Iron concentrations were high, averaging over 1 mg/l at the mouth during surveys number 1 and number 2. Iron concentrations in the Rouge below points of discharge of industrial waste containing iron averaged over 2 mg/l during survey number 2.

Average values of suspended solids ranged from 4 to 55 mg/l, with higher values upstream and higher values at the mouth during the summer survey. Settleable solids observed during the second survey varied from 60 to 90% of the suspended solids found in the River, with the largest values at the mouth.

Of the toxic metals, nickel, zinc, lead, and chromium were consistently found throughout the length of the Rouge River in concentrations ranging from 0.01 to 0.11 mg/l. ABS was found at the mouth at a concentration of 500 μg/l, which was somewhat higher than found in the Detroit River.

The Rouge River is itself polluted to the extent of interference with water uses - including recreation and navigation. It is also a major source of pollution in the lower Detroit River. Most significant of the measures of Detroit River water quality affected by the Rouge are coliform, iron, suspended and settleable solids, and phenol concentrations.

Ecorse River

An intensive survey was conducted on the Ecorse River July 14-18, 1963. The regular sampling station at the mouth indicated high coliform densities, especially during or following rainfall. Several combined sewer outfalls are located along the North Branch of the Ecorse River, and discharge from these sewers was suspected of contributing to the high bacterial densities found at the mouth. No rain occurred during the survey, and the flow of the Ecorse was negligible (less than 1 cfs).

Results of sampling indicated high coliform, chloride, and suspended solids concentrations at the mouth and both branches. Coliform and fecal streptococci densities in the North Branch were significantly higher than those found in the South Branch. Shown below is a brief summary of a range of average values found during this survey.

Constituent	Mouth Ecorse River	North Branch	South Branch
Coliform (org/100 ml)	660,000	18,000-65,000	1,700-31,000
Fecal Strep. (org/100 ml)	25,000	1,200- 5,400	430- 1,300
Chlorides (mg/l)	89	120- 144	106- 249
Suspended Solids (mg/l)	25	81	173
Settleable Solids (mg/l)	5	46	127
ABS (μg/l)	900	-	-

These results indicate pollution from domestic waste sources, probably through overflows from combined sewers, although this could not be verified due to lack of rainfall during the survey period. The densities found probably represent a residual effect from the overflows in this small river plus small undetectable amounts of domestic waste flowing into the River in dry weather.

Monguagon Creek

An intensive survey was conducted on Monguagon Creek July 14-18, 1963. Flow in the Creek is greatly influenced by approximately 11 cfs of industrial waste from the Pennsalt Chemical Company's West Plant. Upstream from this outfall the flow in Monguagon Creek was 0.5 cfs, and downstream it was 12 cfs.

The sampling showed phenol, suspended or settleable solids, nitrogen compounds, and chlorides in the water. Shown below is a summary of average values at the mouth as well as above and below the Pennsalt outfall.

	Mouth	Below Pennsalt	Above Pennsalt
Flow (cfs)	12.0	12.0	0.5
Phenols (μg/l)	1,050	1,230	6
Suspended Solids (mg/l)	131	100	46
Settleable Solids (mg/l)	116	69	26
Chlorides (mg/l)	343	339	210
Ammonia (mg/l)	3.03	2.97	0.49
Org-N (mg/l)	0.62	0.38	0.27
Coliform (organisms/100 ml)	490	190	7,700

The decrease in coliform density below the outfall was due to dilution with low coliform water as well as the bactericidal effect of the industrial waste.

Study of waste loadings shown on the following page revealed the Pennsalt Chemical Company as the major contributor of all constituents mentioned (except bacteria). In fact, the increase in stream loadings below this one source varied from 96 to 99%. All values shown are in pounds per day.

Constituent	Mouth	Below Pennsalt	Above Pennsalt
Phenols	65	80	0.02
Suspended Solids	8,470	6,470	270
Chlorides	22,200	21,900	566

This survey reveals that Monguagon Creek is a major source of phenolic contribution to the Detroit River, and generally speaking, water quality conditions at the mouth of this Creek are representative of the effluent of the Pennsalt-West Chemical Plant.

INTERFERENCES WITH WATER USE

Municipal Water Supply

Three municipal water intakes are located in the Detroit River. Two are located in the lower section of the River below the Rouge and are seriously affected by pollution. The other intake is located near the head of the Detroit River and is relatively free from damaging effects of pollution; it is not discussed here.

Southwest Water Intake - City of Detroit

This intake, located near Fighting Island, usually receives high quality water during dry weather conditions, but following overflows from combined sewers upstream the water contains more than 10,000 coliform organisms per 100 ml. Project data indicate geometric mean coliform densities of approximately 800 organisms per 100 ml during dry conditions and 4,000 organisms per 100 ml during wet conditions. Maximum values exceeding 50,000 coliform organisms per 100 ml have been observed in waters adjacent to this intake following heavy rainfall. The geometric mean coliform density of 9 samples collected at the intake during the summer and early fall of 1964 was 2,240 organisms per 100 ml, with a maximum value of 6,400 organisms per 100 ml and 67% of the samples greater than 2,400 organisms per 100 ml. These values are within limits recommended by the Public Health Service for raw water, but do not compare favorably with water quality in the upper Detroit River.

Analysis of data collected by Wayne County Road Commission personnel during summer months reveals a geometric mean of 1,930 organisms per 100 ml at the intake before its use. Samples collected during fall and winter months indicated water of better bacteriological quality. Breakdown of these results reveals 64% of the samples collected during summer months with values greater than 1,000 per 100 ml, 39% greater than 2,400 per 100 ml and 17% greater than 5,000 per 100 ml. The maximum observed value during this period was 240,000 per 100 ml. No records of raw water results were available after the plant opened in May 1964. This plant serves an estimated population of 200,000.

The effects of pollution upon this water use vary greatly because of its location outside the mainstream of the normal flow of grossly polluted water down the Detroit River. This is fortunate, but changes in weather conditions such as wind and rain can pose a threat to the health and welfare of the users of this supply, particularly when rainfall causes overflows from combined sewers.

City of Wyandotte Water Intake

Raw water records at this intake have been described elsewhere in this report. (See Figure 15-I.) Monthly geometric mean coliform densities during the last 4 years frequently exceeded 10,000 per 100 ml. During the past 2 years monthly geometric mean coliform densities were lower but still exceeded 5,000 per 100 ml quite often during the summer months.

The maximum monthly coliform density exceeded 110,000 during 35 of 48 months during the period 1960-63. Both maximum and geometric mean values are minimized due to the maximum dilution at the plant, which allows specific reporting only for coliform densities equal to or less than 110,000 per 100 ml. If the true values were known (rather than merely greater than 110,000 per 100 ml) the monthly geometric means and maximum values would undoubtedly be higher.

Project data showed water quality at this point to have a geometric mean coliform density of approximately 3,000 per 100 ml during dry conditions and 40,000 per 100 ml during wet conditions. The maximum coliform value observed by Project personnel during the survey at this location exceeded 600,000 per 100 ml.

Such bacteriological levels exceed requirements for a safe and dependable raw water supply. Improvement in operation at the City of Detroit Sewage Treatment Plant has lowered the values during record years to those reported above, but more remains to be done. Pollution in the raw water used as a municipal source by 44,000 persons constitutes an interference with this water supply and a threat to the health and welfare of the consumer.

To add to this already difficult problem, ammonia concentrations in the intake interfere with chlorination so essential to the production of drinking water from this supply. Furthermore, phenol concentrations at the intake have produced unpleasant tastes and odors in the drinking water.

These statements should not be interpreted as criticism of the operation of the Wyandotte water treatment facilities. It merely means that because of pollution, the raw water supply available at this location does not meet accepted levels of bacterial quality and is lower in quality than that which would be expected at a municipal water intake.

Industrial Water Supply

Attempts to acquire information from industries in the study area relative to interference to their water supply due to pollution were generally fruitless.

The Detroit Edison Company, an industry using cooling water only, with several plants located from the head of the Detroit River to its lower reaches, answered inquiries to the effect that no serious problem existed. The Company did report minor troubles at an installation in the Rouge River due to organic matter, and at an installation below Conners Creek following overflow from the nearby combined sewer. In both cases, a Company representative stated that the problem was easily solved by increase in chlorine dosage. This industry was asked for information relative to water treatment costs at their plants, but declined to provide it.

Recreation

Because of pollution, all bathing areas below Belle Isle on the Detroit River have been described as unsafe for swimming and other water-contact sports by State and local health authorities. This restriction affects the lower 26 (out of 31) miles of the Detroit River.

Numerous complaints concerning the effects of pollution were received from boat owners and operators of marina facilities along the lower Detroit River. These were verified by visits to the installations where observation revealed docking facilities fouled with oil and filled in with sludge. Many owners reported significant expense incurred in periodic cleaning or dredging of their docking area to remove accumulated material. Ownership and operation of sports water-craft is big business on the Detroit River, with over 125,000 vessels registered during a recent year. Pollution affecting boating is due to the discharge of oil and settleable suspended solids from municipal and industrial outfalls on the Detroit River.

Swimming and water skiing still occur in the restricted area, and such practice represents a threat to the health and welfare of the user. The restriction, on the other hand, represents an interference with a legitimate water use for those who heed the warning.

Fish and Wildlife Propagation

Although there is no evidence of reduction in total numbers or pounds of fish caught by sports fishermen in the Detroit River, the creel census records of various agencies indicate a change in the predominant types of fish present in the waters from game or sport fish to those of the rough variety, such as carp, often inedible.

Bottom conditions along the lower section of the Detroit River, caused by pollution, represent unfavorable environmental conditions for the propagation of a great variety of game fish and interfere with this water use by limiting the variety to those species capable of survival and propagation in polluted waters.

During the past four years no major duck kill due to pollution has been experienced in the Detroit River. This admirable accomplishment is the result of effective oil pollution control by the Michigan Water Resources Commission with the cooperation of the Michigan Conservation Commission. Major kills have occurred as recently as 1960, however, when over 10,000 birds succumbed. Constant vigilance during critical seasons is required to prevent a recurrence of such a tragedy.

Navigation

Interference with navigation occurs at the junction of the Rouge and Detroit Rivers, where sludge deposits require extensive annual dredging operations by the Corps of Engineers to keep navigable waters in use. The deposits of suspended solids originate partly in the discharge from several industries along the Rouge. This fact is recognized by both the industries and the Corps who make a charge for this service to the polluters involved. Deposition of suspended solids also occurs at harbor facilities and at the mouth of the Detroit River in the navigation channels.

SECTION VI

PRESENTATION OF RESULTS:

LAKE ERIE

DESCRIPTION OF WATER QUALITY

The Michigan waters of Lake Erie constitute approximately 1 per cent of its total surface area, and all the determinations in this report are limited to those waters. A series of maps on which the contours of various measures of water quality are described will be presented, along with tables giving the results of sampling. Both will be accompanied by interpretation. The sampling stations in Lake Erie, along its bathing beaches and on its tributaries, are shown in Figure 2-I.

Bacteriological

Bacteriological densities in Lake Erie from the mouth of the Detroit River to a distance from 2 to 3 miles below this point indicate that the water is polluted to the extent that it cannot safely be used for recreational purposes. Following heavy rainfall in the Detroit area, bypassing of excess waste from the Detroit treatment plant extends the zone of polluted water southward to just north of Stony Point. Both the International Joint Commission objective (2,400 coliform organisms per 100 ml) and the standard commonly used for recreational use of water (1,000 per 100 ml) are exceeded in the zone of Lake Erie influenced by the Detroit River. A similar, less extensive zone radiates from the mouth of the Raisin River. This zone of polluted water also extends farther out into the Lake following heavy rainfall.

Figure 1-VI depicts geometric mean coliform values in the Lake as contours. Most of the Michigan area of the Lake had average coliform densities under 500 organisms per 100 ml. Two areas of high density are evident from Figure 1-VI. The first extends below the mouth of the Detroit River south to just above Stony Point, while the other radiates out into the Lake a short distance from the Raisin River; each is apparently caused by separate waste contributions from the two tributaries, and they do not appear to be associated with each other. Geometric mean coliform densities greater than 5,000 organisms per 100 ml were observed at the mouth of the Detroit River as it entered Lake Erie. An area of geometric mean coliform density exceeding the International Joint Commission objective (2,400 organisms per 100 ml) extended down into Lake Erie for a distance of 2 to 3 miles.

Maximum coliform densities at several locations showed a similar pattern (Figure 2-VI). Again two zones of high values were found, in the same locations described above. The maximum observed outside the two zones of especially polluted water was 42,000 organisms per 100 ml, while maximum values exceeding 100,000 organisms per 100 ml were observed near the mouths of the Detroit and Raisin Rivers.

Average fecal coliform densities in Lake Erie ranged from 5 to 30 per cent of the total coliform density; geometric mean fecal streptococcus densities in Lake Erie were under 80 organisms per 100 ml at all locations.

All bathing beaches along Lake Erie showed geometric mean coliform densities less than 1,000 organisms per 100 ml, except Maple Beach (B1) which is located in the influence of the polluted Detroit River. The relatively low means at the Sterling State Park beaches are misleading due to high maximums which appear under certain relatively frequent conditions of wind and weather. Since these values are masked in median or geometric mean values, a special survey was made on this beach, described later in this section of the report. Average fecal coliform densities at the beaches ranged, without a noticeable pattern, from 23 to 72 per cent of the total coliform values. Fecal streptococcus geometric means at the beaches ranged from 13 to 430 organisms per 100 ml. Bathing beaches from Otter Creek to the Ohio State line had geometric mean coliform densities less than 350 organisms per 100 ml; maximum coliform densities at these locations did not exceed 3,000 organisms during the survey.

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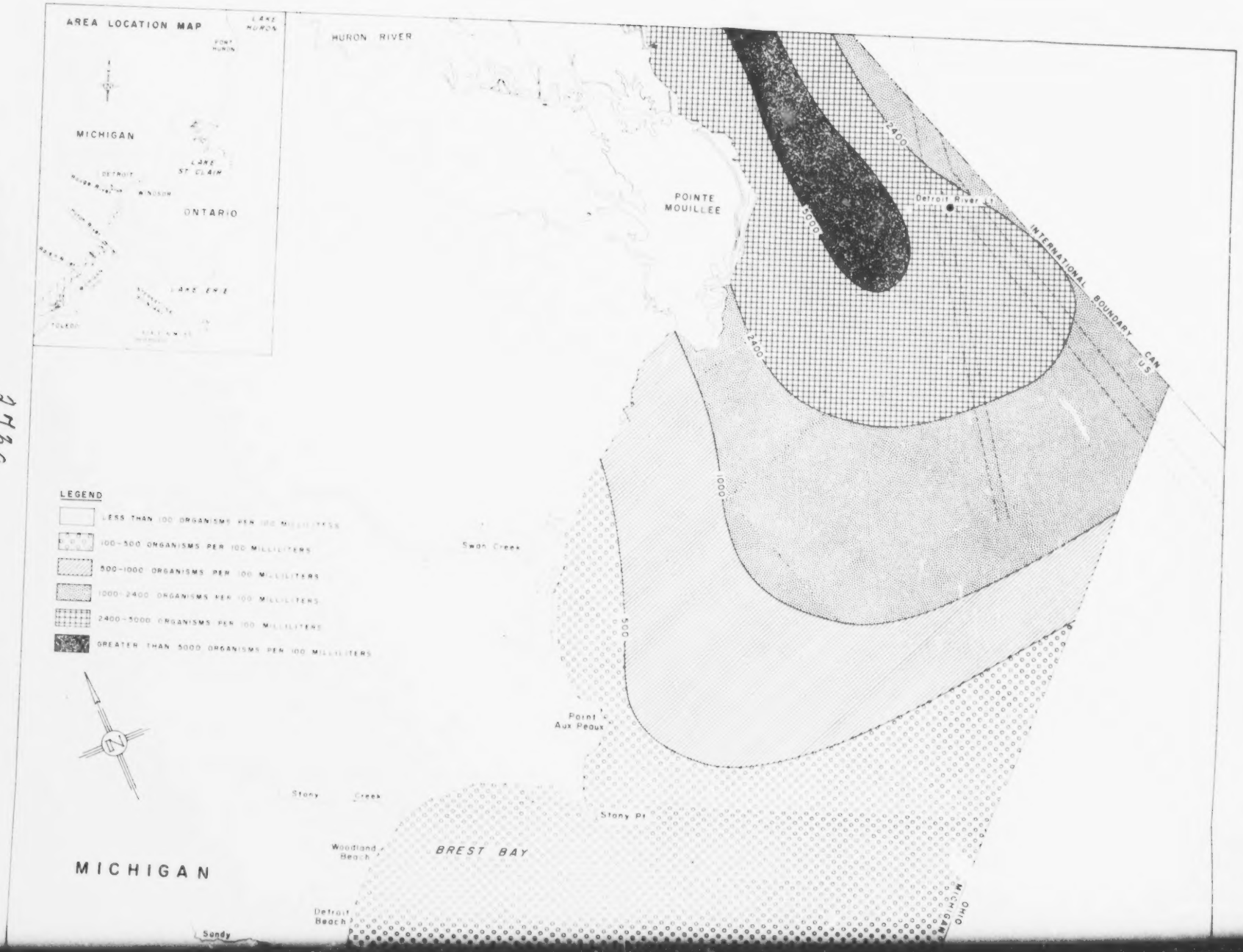
Coliform densities were highest at the mouths of the tributaries. Table 3-VI shows geometric mean coliform densities in excess of 1,500 organisms per 100 ml at the mouths of all Lake Erie tributaries. Highest counts were at Plum Creek, averaging 49,000 coliform organisms per 100 ml, and at the Raisin River, averaging 30,000. Fecal coliform densities were also high here, ranging from 32 to 68 per cent of the total values. Fecal streptococcus densities in Plum Creek averaged 2,500 organisms per 100 ml, while those at all other tributaries averaged under 1,000. Maximum coliform densities exceeding 25,000 organisms per 100 ml were found in all tributaries. The maximum value found in Plum Creek exceeded 1 million organisms per 100 ml.


AREA LOCATION MAP
LAKE HURON
PORT HURON
MICHIGAN
DETROIT
LAKE ST CLAIR
WINDSOR
ONTARIO
LAKE ERIE
TOLEDO
HURON RIVER
POINTE MOUILLEE
Detroit River
INTERNATIONAL BOUNDARY
CAN
U.S.
2400
5000
2400
1000
500
LEGEND
LESS THAN 100 ORGANISMS PER 100 MILLILITERS
100-500 ORGANISMS PER 100 MILLILITERS
500-1000 ORGANISMS PER 100 MILLILITERS
1000-2400 ORGANISMS PER 100 MILLILITERS
2400-5000 ORGANISMS PER 100 MILLILITERS
GREATER THAN 5000 ORGANISMS PER 100 MILLILITERS
N
Swan Creek
Point Aux Peaux
Stony Pt
Stony Creek
Woodland Beach
BREST BAY
MICHIGAN
Detroit Beach
Sandy
OHIO
MICHIGAN

273a

N
Stony Creek
Stony Pt
Woodland Beach
BREST BAY
MICHIGAN
OHIO
Detroit Beach
Sandy Creek
STERLING STATE PARK
1000
500
2400
100
RAISIN
RIVER
MONROE
Plum Creek
La Plaisance Creek
Bolles Harbor
Otter Creek
Toledo Beach
100
Long Pier
LAKE ERIE

2736

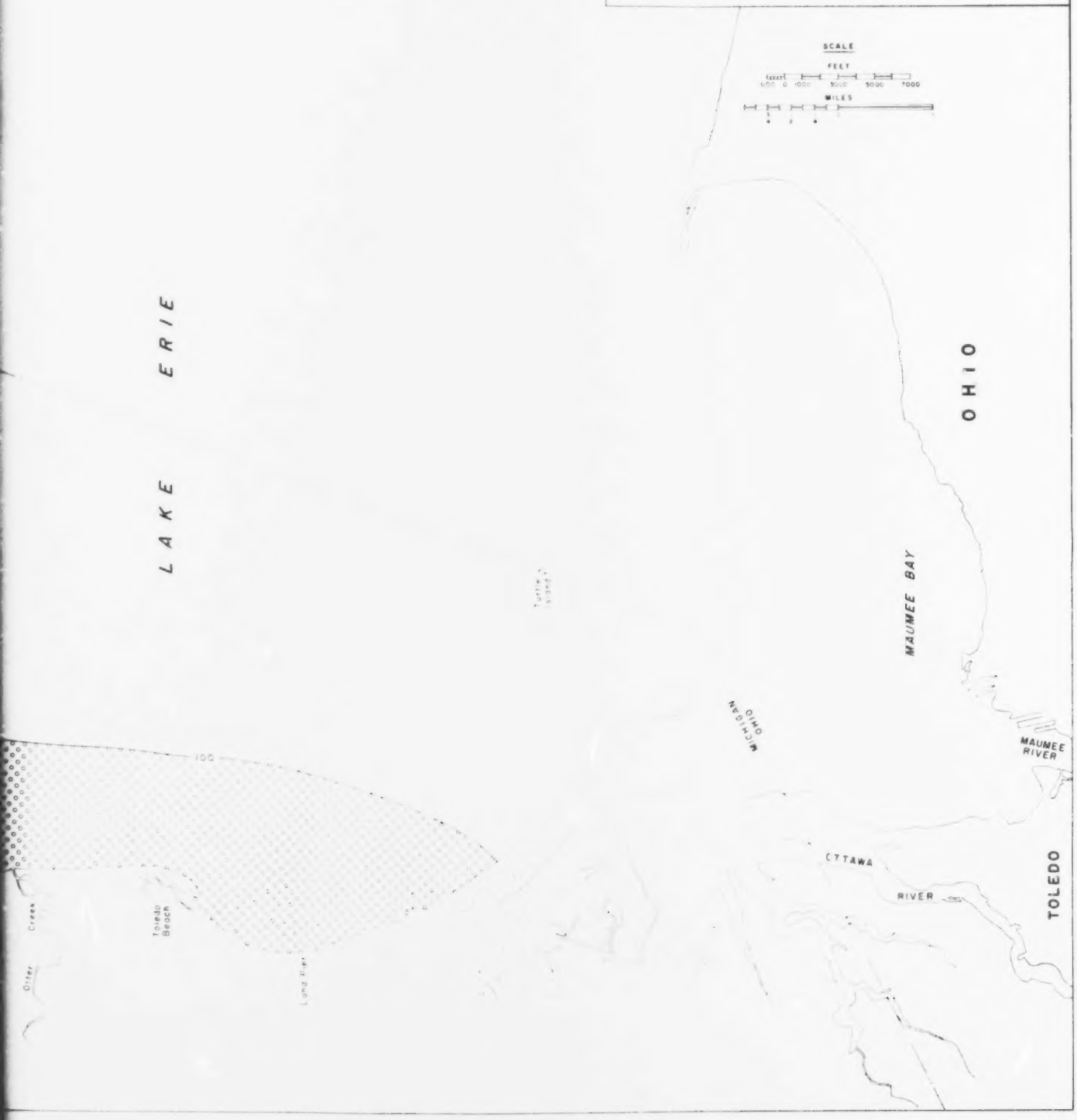
FIGURE I-VI

DETROIT RIVER-LAKE ERIE PROJECT

GEOMETRIC MEAN COLIFORM CONCENTRATIONS

MICHIGAN WATERS OF LAKE ERIE

U.S. DEPARTMENT OF HEALTH, EDUCATION, AND WELFARE
PUBLIC HEALTH SERVICE
REGION V GROSSE ILE, MICHIGAN



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AREA LOCATION MAP
LAKE HURON
PORT HURON
MICHIGAN
LAKE ST. CLAIR
DETROIT
WINDSOR
ONTARIO
LAKE ERIE
TOLEDO
HURON RIVER
370,000
25,000
140,000
57,000
56,000
POINTE MOUILLEE
Detroit River
110,000
INTERNATIONAL BOUNDARY
CAN
US
75,000
97,000
240,000
30,000
81,000
26,000
LEGEND
17,000 ORGANISMS PER 100 MILLILITERS
190,000
Swan Creek
42,000
100,000
23,000
Point Aux Peaux
42,000
Stony Creek
32,000
Stony Pt
Woodland Beach
62,000
BREST BAY
37,000
33,000
MICHIGAN
1,700
36,000
Detroit Beach
86,000
OHIO
MICHIGAN

213 d

42,000
Stony Pt.
BREST BAY
MICHIGAN
Woodland Beach
62,000
37,000
33,000
1,700
36,000
Detroit Beach
86,000
Landy
460,000
96,000
230,000
2,400
2,500
72,000
RAISIN
RIVER
7,400
2,700
MONROE
1,200,000
6,400
1,200
La Plaisance
Creek
44,000
Tolles Harbor
3,100
51,000
4,700
8,000
Otter
Creek
2,200
Toledo Beach
2,000
LAKE ERIE
Luna Pier
3,000

FIGURE 2-XI

DETROIT RIVER–LAKE ERIE PROJECT

MAXIMUM COLIFORM CONCENTRATIONS

MICHIGAN WATERS OF LAKE ERIE

U.S. DEPARTMENT OF HEALTH, EDUCATION, AND WELFARE
PUBLIC HEALTH SERVICE
REGION V GROSSE ILE, MICHIGAN

TABLE 1-VI. SUMMARY OF AVERAGE RESULTS IN MICHIGAN LAKE ERIE

Station	pH	Phenols µg/l	Chloride mg/l	Alkalinity mg/l	Geometric Mean Coliform org/100ml	Geometric Mean Fecal Strep org/100ml	Geometric Mean Fecal Coli org/100ml	Phosphates mg/l	Nitrates mg/l	Nitrites mg/l	Ammonia Nitrogen mg/l	Organic Nitrogen mg/l
L2	8.07	2	14	79	2,000	16	360	.17	.15	.003	.09	.13
L3	8.12	2	25	79	6,000	23	1,620	.35	.12			
L4	8.08	3	44	85	3,500	12	550					
L5	7.95	2	18	79	3,700	15	670	.32	.24	.003	.34	.12
L6	8.14	1	20	79	1,600	80	320		.24			
L7	8.13	1	19	80	1,900						.34	.18
L8	8.22	2	24	82	640			.20	.15	.003	.24	.12
L9	8.25	2	18	119	330			.12	.12	.002	.39	.14
L10	8.44	2	21	83	130			.22	.26			
L11	8.36	6	22	80	69			.14	.10	.002	.05	.08
L12	8.33	1	25	79	200			.24	.39	.003	.13	.23
L14	8.46	4	25	81	160	5	21	.13	.53	.001	.18	.23
L15	8.46	1	20	78	88						.34	.37
L17	8.41	2	22	78	36			.11	.34			
L20	8.58	1	23	81	55			.25	.19	.001	.12	.12
L21	7.63	0	35	84	5,000	29	1,250	.33	.14			
L22	8.13	1	46	84	260	9	13	.78	.32	.006	.27	.17
L23	8.32	2	29	84	130	8	22	.24	.44	.001	.23	.17
L24	8.19	5	24	81	84	5	25	.29	.44	.001	.17	.15
L25	8.30	16	26	85	48	5					.43	.54
L26	8.19	-	25	84	19			.31	.15	.030	.10	.25
L27	8.44	2	29	81	88	7	5				.41	.47
L28	8.44	2	24	86	69	7	7	.11	.49	.002	.16	.33
											.58	.62

TABLE 2-VI. SUMMARY OF AVERAGE RESULTS
MICHIGAN LAKE ERIE BATHING BEACHES

Station	pH	Phenols µg/l	Chloride mg/l	Alkalinity mg/l	Geometric Mean Coliform org./100 ml	Geometric Mean Fecal Strep org./100 ml	Geometric Mean Fecal Coli org./100 ml
B1	8.42	2	65	93	2,000	79	680
B3	8.51	2	44	85	960	13	320
B4	8.50	2	41	86	480	60	180
B5	8.51	3	33	79	490	53	152
B7	8.63	3	28	78	340	130	180
B8	8.66	4	27	79	480	77	200
B10	8.61	4	28	76	480	69	254
B14	8.60	3	25	87	360	50	83
B17	8.59	3	25	76	430	90	206
B18	8.51	2	25	83	500	51	190
B21	8.50	3	27	83	990	37	178
B22	8.43	4	26	85	460	430	207
B23	8.68	3	24	82	860	200	490
B25	8.74	2	25	81	300	190	111
B27	8.68	1	32	83	210	190	67
B29	8.81	1	24	87	170	53	123
B31	8.73	2	27	93	350	170	170

TABLE 3-VI. SUMMARY OF AVERAGE RESULTS TRIBUTARIES TO MICHIGAN LAKE ERIE

Tributary	pH	Phenols µg/l	Chloride mg/l	Alkalinity mg/l	Geometric Mean Coliform org./100 ml	Geometric Mean Fecal Strep org./100 ml	Geometric Mean Fecal Coli org./100 ml
Huron River	8.37	3.1	36	145	13,000	560	5,700
Swan Creek	8.19	4	94	106	4,100	150	1,350
Stony Creek	8.22	2	26	186	1,700	370	610
Sandy Creek	8.19	3	82	188	5,600	730	1,800
Raisin River	7.93	7	27	125	30,000	85	13,200
Plum Creek	7.77	16	31	221	49,000	2,500	21,500
LePlaisance Creek	8.05	2	40	130	2,400	180	1,630

TABLE 4-VI. SUMMARY OF MAXIMUM VALUES FOUND IN MICHIGAN LAKE ERIE

Station	pH	Phenols µg/l	Chloride mg/l	Alkalinity mg/l	Coliform org./100 ml	Fecal Strep org./100 ml	Fecal Coli % of Total
L2	8.4	6	44	82	56,000	45	42
L3	8.7	8	58	80	110,000	88	45
L4	8.7	9	82	89	75,000	60	45
L5	8.6	15	44	80	97,000	58	55
L6	8.8	5	48	80	30,000	85	20
L7	9.1	4	48	81	42,000	-	-
L8	9.2	7	37	87	100,000	--	-
L9	8.7	7	55	157	23,000	-	-
L10	8.9	6	37	85	3,000	-	-
L11	9.0	58	47	82	2,500	-	-
L12	8.8	6	46	81	36,000	-	-
L14	9.0	28	41	84	6,400	L 10	25
L15	8.8	8	30	82	7,400	-	-
L17	8.8	9	35	78	1,200	-	-
L20	9.0	5	28	82	1,000	10	-
L21	8.0	0	58	84	57,000	310	40
L22	8.7	3	74	84	81,000	55	5
L23	8.8	2	39	86	1,700	75	25
L24	8.8	17	36	84	2,400	L 10	30
L25	8.8	30	34	87	4,700	L 5	-
L26	8.6	-	31	85	140	-	-
L27	8.8	2	34	84	2,700	20	5
L28	9.0	4	27	86	2,000	20	10

TABLE 5-VI. SUMMARY OF MAXIMUM VALUES FOUND AT MICHIGAN LAKE ERIE BATHING BEACHES

Station	pH	Phenols µg/l	Chloride mg/l	Alkalinity mg/l	Coliform org./100 ml	Fecal Strep org./100 ml	Fecal Coli % of Total
B1	9.0	14	82	93	25,000	2,000	100
B3	9.2	5	80	88	240,000	850	70
B4	9.0	8	80	89	190,000	200	100
B5	9.0	8	75	82	42,000	380	58
B7	9.1	10	71	81	62,000	2,000	95
B8	9.1	13	79	81	37,000	1,400	100
B10	9.2	15	78	78	33,000	2,500	100
B14	9.2	8	37	99	86,000	420	40
B17	9.2	7	31	80	96,000	500	80
B18	9.3	8	30	88	230,000	250	80
B21	9.4	9	49	87	72,000	160	40
B22	9.3	14	42	90	3,100	3,700	85
B23	9.3	10	36	86	51,000	1,800	90
B25	9.4	8	31	86	8,000	3,500	100
B27	9.3	4	149	87	2,200	2,100	60
B29	9.5	3	30	90	2,000	740	100
B31	9.4	13	37	103	3,000	1,500	90

TABLE 6-VI. SUMMARY OF MAXIMUM VALUES FOUND ON TRIBUTARIES TO MICHIGAN LAKE ERIE

Tributary	pH	Phenols µg/l	Chloride mg/l	Alkalinity mg/l	Coliform org./100 ml	Fecal Strep org./100 ml	Fecal Coli % of Total
Huron River	9.1	14	47	163	140,000	2,800	75
Swan Creek	8.5	12	193	109	26,000	400	45
Stony Creek	8.5	8	38	190	32,000	1,100	95
Sandy Creek	8.8	8	180	198	460,000	6,100	82
Raisin River	8.8	36	33	153	530,000	560	100
Plum Creek	8.1	175	94	234	1,200,000	9,200	60
LaPlaisance Creek	8.7	6	59	145	44,000	400	95

Chemical and Physical

Phenols

With few exceptions, IJC objectives for average phenol concentrations (2 μg/l) were met during the survey. There is no evidence that phenols in the Michigan waters of Lake Erie constitute interference with water use at this time.

Average phenol concentrations in the Lake and along shore ranged from 1 to 16 μg/l, with 5 out of 23 stations exceeding the IJC limit (2 μg/l). The few locations with high phenol concentrations showed no apparent pattern, and were not located in the vicinity of either the mouth of the Detroit or Raisin Rivers. Maximum phenol values appeared, generally, at the same stations, with one maximum value as high as 58 μg/l at station L 11.

All beaches had average phenol concentrations less than 5 μg/l with most equal to or less than 2 μg/l. Plum Creek, averaging 16 μg/l, and the Raisin River, at 7 μg/l, were the only tributaries with phenols exceeding 4 μg/l. Phenol concentrations near the City of Monroe intake averaged 2 μg/l.

Chlorides

Average chloride concentrations in the Michigan water of Lake Erie ranged from 18 to 44 mg/l, with the higher values alongshore and near the mouth of the Detroit River. Average chloride concentrations in Lake Erie are shown as contours in Figure 3-VI. The influence of the Trenton Channel of the Detroit River on chloride concentrations in Lake Erie is clearly shown in this figure, and is felt as far south as Stony Point. A maximum value of 82 mg/l was observed near the mouth of the Detroit River. A maximum value of 74 mg/l was noted near the mouth of the Raisin River.

Chloride levels found in the Michigan waters of Lake Erie are 3 to 5 times higher than those found at the head of the Detroit River but are not high enough to interfere with water use. However, a year-by-year increase has been noted at the City of Monroe water intake (see Figure 13-1) which may present future difficulties.

pH

Along shore and in the Michigan waters of Lake Erie, pH values ranged from 7.6 to 8.8. The lowest pH values were found near the mouth of the Detroit River, and the highest values were found in the southern part of the Michigan waters.

pH values found in Lake Erie do not indicate a problem at this time.

Suspended and Settleable Solids

Average suspended solids ranged from 11 to 25 mg/l, with the higher values near the Raisin and Detroit Rivers. Average settleable solids were low, ranging from 1 to 4 mg/l. Solids at certain bathing beaches were considerably higher, with suspended solids averaging 80 - 165 mg/l at Sterling State Park and Bolles Harbor beaches, just north and south, respectively, of the mouth of the Raisin River. Suspended and settleable solids in the Raisin River itself averaged 20 and 9 mg/l respectively.

Suspended solids in Lake Erie, in the vicinity of the mouths of the Raisin and Detroit Rivers and near the shores, have reached levels which constitute damaging pollution. The solids settle on the Lake bottom, as sludge or bottom deposits, causing

damage to aquatic life. By blanketing the bottom, sludge deposits are killing eggs and essential fish-food organisms, and destroying spawning beds.

Cyanides

No cyanide was found in Lake Erie or at its beaches, except one concentration of 0.03 mg/l at Sterling State Park. Cyanides in the Raisin River averaged 0.03 mg/l at its mouth.

Cyanide concentrations found in the Raisin River and in Lake Erie near the mouth of the Raisin indicate a potential interference with water use from the standpoint of fish and wildlife propagation. This condition appears to be limited to a small area of the Lake immediately adjacent to the mouth of the Raisin River.

Iron

An area adjacent to and south of the mouth of the Raisin River has iron concentrations ranging between 0.21 and 0.64 mg/l. Iron concentrations in the northern part of the Michigan waters of Lake Erie were low (0.01 mg/l).

Iron concentrations in Lake Erie exceed the IJC objective (.03 mg/l) in the waters adjacent to and south of the mouth of the Raisin River. They represent potential interference with water supply and aquatic life.

Toxic Metals

These metals consist of cadmium, chromium, copper, lead, nickel, and zinc.

All except cadmium were detected in the Michigan waters of Lake Erie above the 0.01 mg/l level. The occurrence of metals seemed to be greater in the waters south of Stony Point.

Copper, chromium and zinc ranged from 0.01 to 0.07 mg/l, with the higher values adjacent to the mouth of the Raisin River. Lead ranged from 0.01 to 0.12 mg/l, with the higher values again in the vicinity of the mouth of the Raisin. All nickel concentrations were 0.02 mg/l or less, and, as mentioned before, cadmium was not detected at the sensitivity of the test (0.01 mg/l). Toxic metals were found above minimum detectable concentrations in the area extending outward 2 to 4 miles from the mouth of the Raisin River.

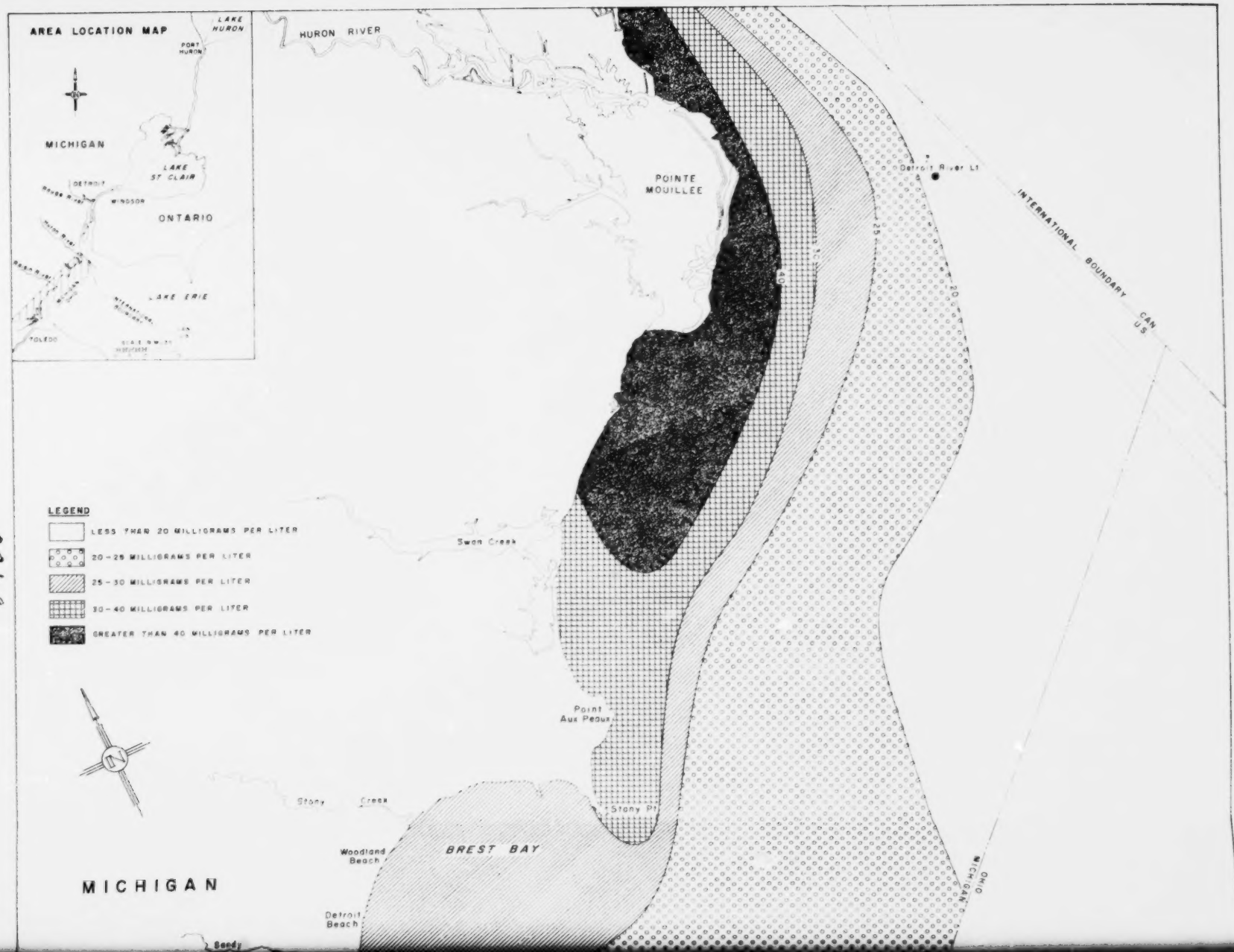
At this time toxic metals in Lake Erie do not cause interference with water use. However, maximum values of chromium and lead found near the mouth of the Raisin River indicate potential future problems.

ABS

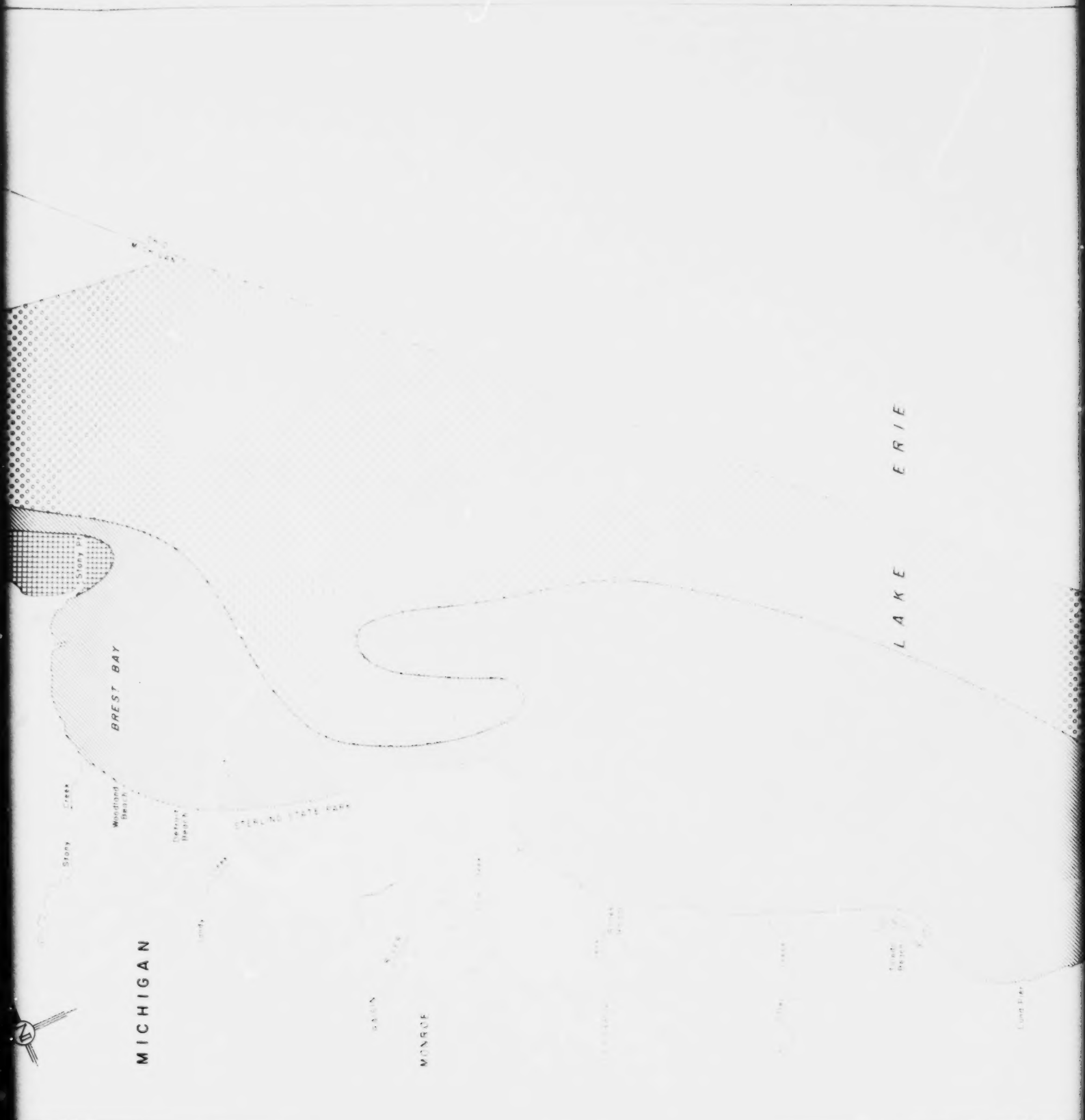
All concentrations of alkyl benzene sulfonate found in the Michigan waters of Lake Erie were less than 25 μg/l, far less than the amount which is expected to cause foaming (500 μg/l). There is no interference with water use from this constituent.

Dissolved Oxygen

Levels of DO in most of the Michigan waters of Lake Erie are sufficient at this time to prevent interference with water use. At the mouth of the Raisin River, however, and to some extent in the influence of the Detroit River, significant decrease in oxygen


AREA LOCATION MAP
LAKE HURON
PORT HURON
MICHIGAN
LAKE ST CLAIR
DETROIT
WINDSOR
ONTARIO
LAKE ERIE
TOLEDO
HURON RIVER
POINTE MOUILLEE
Detroit River Lt
INTERNATIONAL BOUNDARY CAN US
40
30
25
20
LEGEND
LESS THAN 20 MILLIGRAMS PER LITER
20-25 MILLIGRAMS PER LITER
25-30 MILLIGRAMS PER LITER
30-40 MILLIGRAMS PER LITER
GREATER THAN 40 MILLIGRAMS PER LITER
Swan Creek
Point Aux Peaux
Stony Pt
Stony Creek
BREST BAY
Woodland Beach
Detroit Beach
MICHIGAN
OHIO
MICHIGAN

281 a


LAKE ERIE
BREST BAY
Stony Pt
Stony Creek
Woodland Beach
Detroit Beach
STERLING STATE PARK
MICHIGAN
MONROE
Lund Pier

281 b

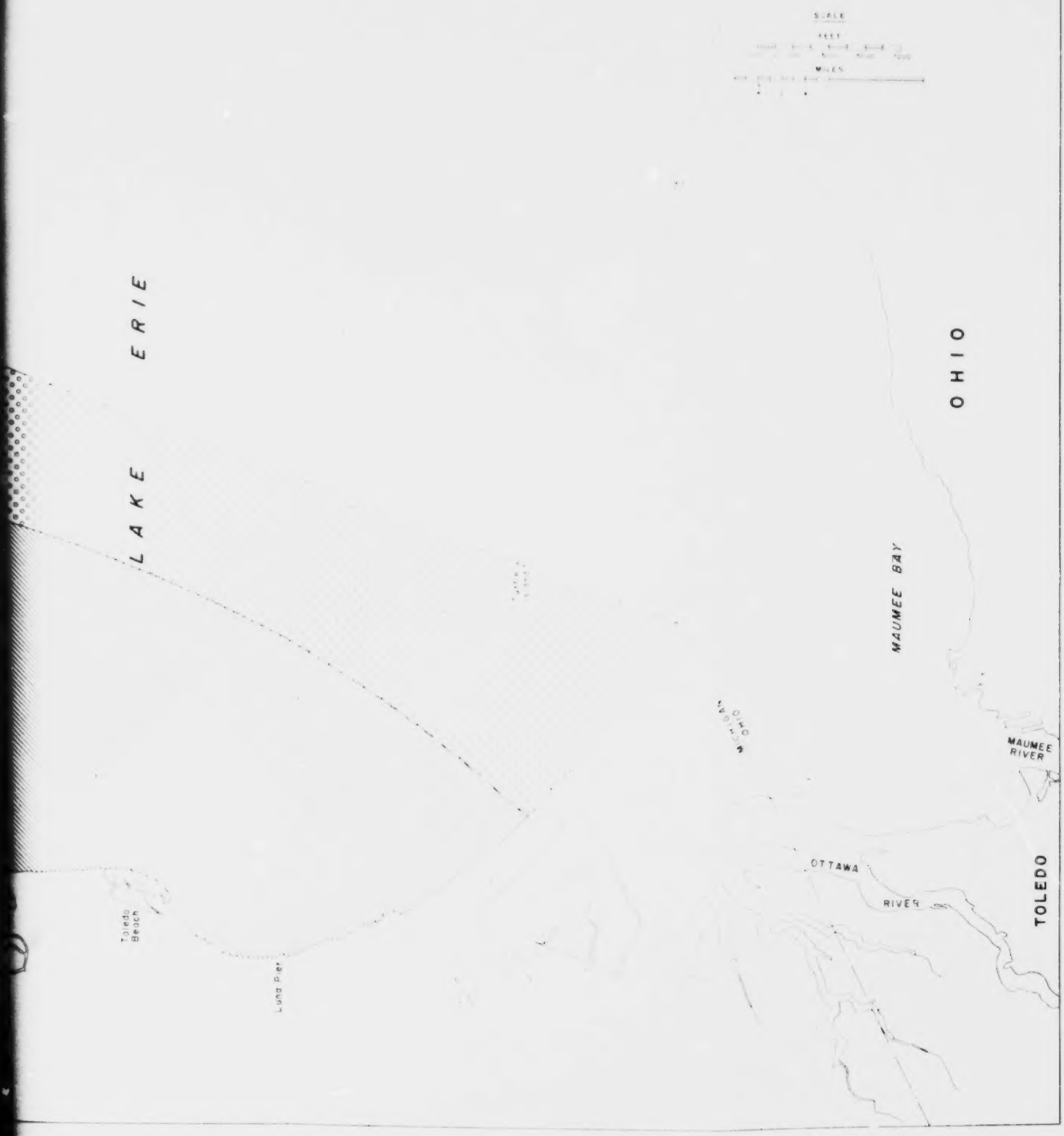
FIGURE 3-XI

DETROIT RIVER–LAKE ERIE PROJECT

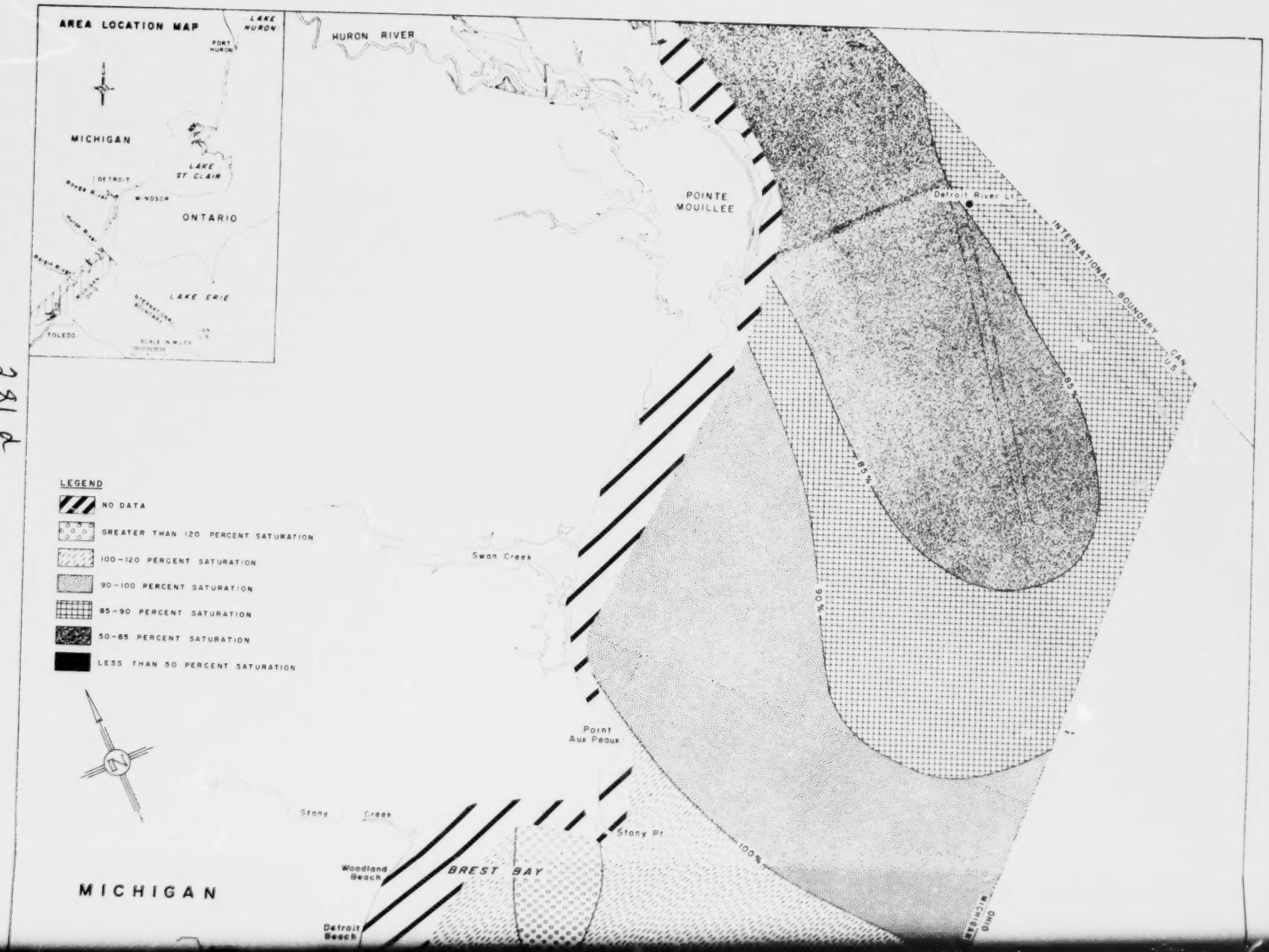
AVERAGE CHLORIDE CONCENTRATIONS

MICHIGAN WATERS OF
LAKE ERIE

U.S. DEPARTMENT OF HEALTH, EDUCATION, AND WELFARE
PUBLIC HEALTH SERVICE
REGION V GROSSE ILE, MICHIGAN



281 C


AREA LOCATION MAP
LAKE HURON
PORT HURON
MICHIGAN
LAKE ST CLAIR
DETROIT
WINDSOR
ONTARIO
LAKE ERIE
TOLEDO
HURON RIVER
POINTE MOUILLEE
Detroit River Lt
INTERNATIONAL BOUNDARY
CAN
U.S.
85 %
90 %
100 %
LEGEND
NO DATA
GREATER THAN 120 PERCENT SATURATION
100-120 PERCENT SATURATION
90-100 PERCENT SATURATION
85-90 PERCENT SATURATION
50-85 PERCENT SATURATION
LESS THAN 50 PERCENT SATURATION
Swan Creek
Point Aux Peaux
Stony Creek
Stony Pt
Woodland Beach
BREST BAY
Detroit Beach
MICHIGAN
OHIO

281 d

OHIO
MICHIGAN
LAKE ERIE
100%
120%
120%
100%
100%
90%
85%
Stony Pt
BREST BAY
Woodland Beach
Detroit Beach
STERLING STATE PARK
Stony Creek
Sandy Creek
MICHIGAN
RAISIN RIVER
MONROE
Plum Creek
Bolles Harbor
Creek
Otter Creek
Toledo Beach
Luna Pier

281 e

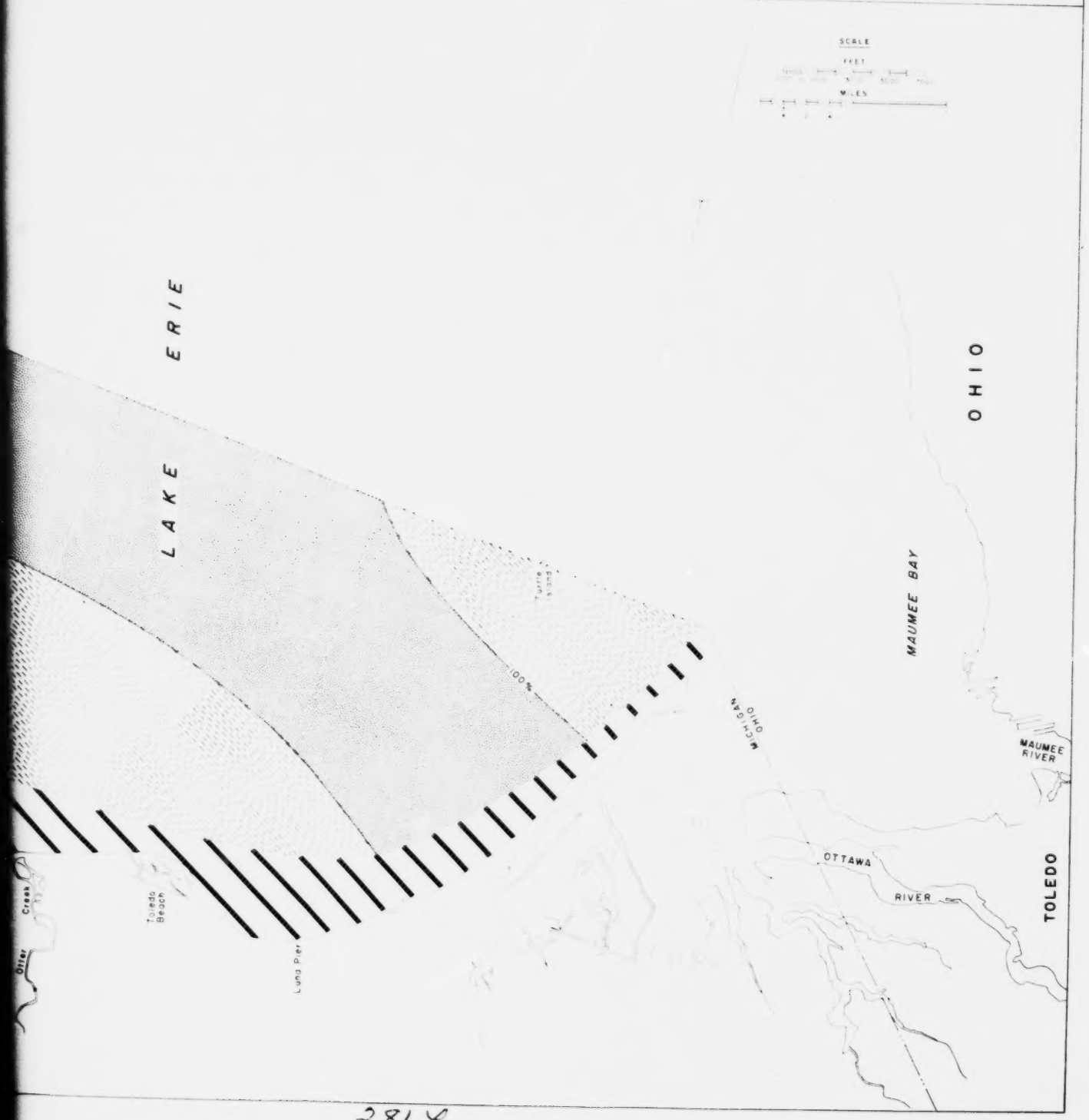
FIGURE 4-VI

DETROIT RIVER-LAKE ERIE PROJECT

AVERAGE % SATURATION DISSOLVED OXYGEN

MICHIGAN WATERS OF LAKE ERIE

U.S. DEPARTMENT OF HEALTH, EDUCATION, AND WELFARE
PUBLIC HEALTH SERVICE
REGION V GROSSE ILE, MICHIGAN



281

content has occurred. If oxygen-consuming materials continue to be added to the Lake from the Detroit and Raisin Rivers, DO deficits will occur and cause serious problems.

Figure 4-VI depicts oxygen saturation contours for Lake Erie. These are average values calculated on the basis of both surface and depth samples. The difference between surface and depth samples ranged between 5 and 20 percent during fall surveys, and as much as 90 percent during spring and early summer surveys, in the deeper sections of the Lake. The lowest actual dissolved oxygen concentrations were found, as expected, during summer months, in areas adjacent to the mouths of the Raisin and Detroit Rivers.

A band of low DO, less than 50 percent saturation, extended out from the Raisin River for a distance of 1/2 to 3/4 mile. In this small area there was occasional complete depletion of DO. The zero DO values were concentrated in the mouth of the Raisin River hydrologically speaking, especially since within one mile of the average values recovered to 100 percent saturation.

A second area of relatively low DO was found immediately below the mouth of the Detroit River in a finger extending southward for a distance of 4 to 6 miles. Average values here were under 85 percent saturation; the minimum value was 4.8 mg/l, just off Pointe Mouillee.

Excluding these two areas, the lowest value in Lake Erie was at Station L17: 5.6 mg/l at 24 feet. The corresponding surface sample was 11.9 mg/l. An area of exceptionally high DO was found in the Brest Bay area where averages exceeded 120 percent saturation. Such high values in natural waters are normally associated with algal growth and subsequent production of oxygen.

Temperature

Temperature values in the Michigan waters of Lake Erie reached a high of 24.5°C, or 76° F. On some days during fall and winter months temperatures varied only 1° throughout the Lake; during spring and early summer surveys, however, differences throughout the Lake as great as 6° were observed. Average temperatures in the Lake during the spring and summer tended to be slightly higher than those in the Detroit River; during the fall no difference between the two bodies of water was observed. Differences at specific stations between surface and depth samples were less than 1°C during fall and winter months, but increased to 3° and 4° during the spring and early summer at the deeper stations on Lake Erie.

Temperature levels in the Michigan waters of Lake Erie do not at present interfere with water use.

Nitrogen Compounds

Over 85% of the Michigan waters of Lake Erie contain inorganic nitrogen in concentrations above the level which produces undesirable algal blooms. These growths represent serious interference with water use, and contribute to the premature nutritive enrichment, or aging, of the Lake.

Figure 5-VI shows average nitrate concentrations as contours in the Michigan waters of Lake Erie. The fluming effect from the mouth of the Detroit River noticeable in the dispersion of other pollutants was not present in the distribution of nitrates. These did radiate out from the mouth of the Raisin River, however. Immediately surrounding the mouth of the River average values were greater than 0.50 mg/l; around Sterling State Park average concentrations ranged to 0.35 to 0.50 mg/l. Another area of high nitrate concentration was observed off Pointe Mouillee, with values above 0.35 mg/l average.

Daily values in the Brest Bay area reached maximums early in May (0.91 mg/l), minimums in September (0.11 mg/l), and then rose again in October and December (to 0.24 mg/l).

Nitrite values in the Lake averaged between less than 0.0001 mg/l to 0.0009 mg/l, with no noticeable pattern in the distribution of these values.

Nitrates and nitrites in the Lake study area do not, at this time, interfere with water uses.

Ammonia nitrogen average concentrations are shown in Figure 6-VI. Fluming effects from the mouths of both the Detroit and Raisin Rivers were noticeable. A mass of water with concentrations exceeding 0.30 mg/l extended about ten miles into the Lake from the Detroit River. Average concentrations exceeding 0.30 mg/l radiated about 1/2 mile into the Lake from the mouth of the Raisin River, and values exceeding 0.20 mg/l were found for one to two miles further.

Average ammonia concentrations of 0.20 mg/l and above near the City of Monroe water intake indicate water treatment difficulties and the need for excessive dosage of chlorine to achieve adequate disinfection.

Average concentrations of all organic nitrogen in the Michigan waters of Lake Erie are shown in Figure 7-VI. The northern part of the Michigan waters had values of less than 0.20 mg/l for the most part. The portion of the Lake extending along the shore from the Raisin River to the Michigan-Ohio State line along the Michigan shore had average organic nitrogen values between 0.20 and 0.30 mg/l. A small area just off the mouth of the Raisin River had values exceeding 0.30 mg/l.

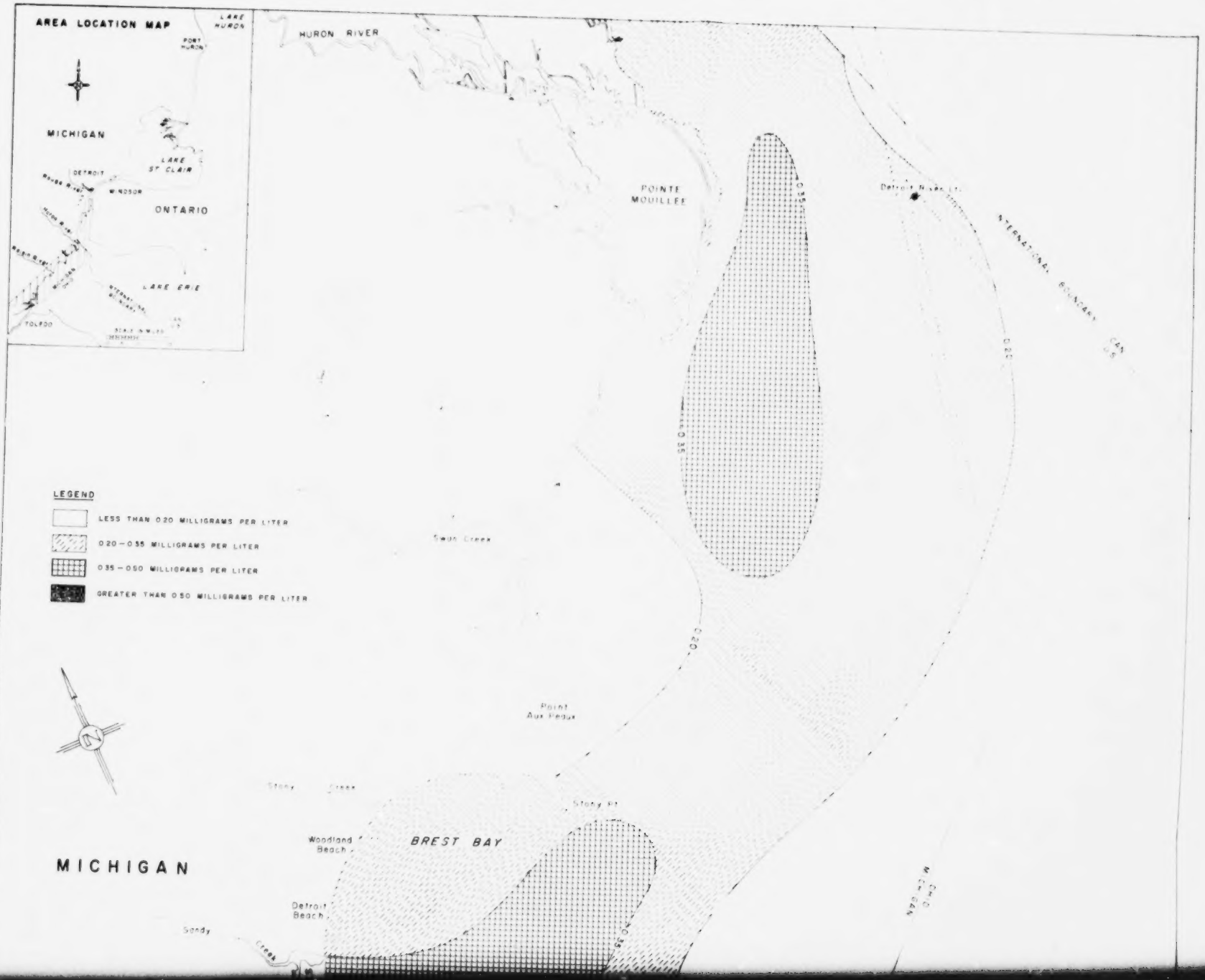
Figure 8-VI shows average values of all inorganic nitrogen in the Michigan waters of Lake Erie. All but a small segment of the southern part of Michigan Lake Erie near Toledo had average inorganic nitrogen concentrations in excess of 0.30 mg/l. Two areas near the mouths of the Detroit and Raisin Rivers had average inorganic nitrogen concentrations in excess of 0.60 mg/l.

Phosphates

Concentrations of soluble phosphates in almost the entire Michigan portion of Lake Erie exceeded 0.015 mg/l as phosphorus. (To convert soluble phosphates reported as phosphates to those reported as phosphorus, divide by three.) Combined with the high concentrations of nitrogen compounds, the phosphates contribute an excess of nutritive matter to the Lake, accelerating its aging, or eutrophication. Over 85% of the Michigan waters of Lake Erie contain soluble phosphorus in concentrations sufficient to create nuisance algal blooms and concomitant damages.

Areas of high total phosphate concentration (0.20 - 0.50 mg/l), reported as phosphate, extended from the mouth of the Detroit River into Lake Erie as far south as Stony Point (Figure 9-VI). Daily average total phosphate concentrations for the entire Lake varied from 0.18 mg/l in the spring to over .30 mg/l in late fall and early winter. Another small zone of high total phosphate concentrations (.30 - .40 mg/l) extended outward from the mouth of the Raisin River about one mile.

Soluble phosphate values (shown in Figure 10-VI) indicated three areas of high concentrations of this constituent. One extended down 6 to 8 miles from the mouth of the Detroit River, with concentrations varying from 0.10 to greater than 0.20 mg/l as phosphate (0.033 to 0.65 mg/l as phosphorus). The second area of high concentration radiated outward 1 to 2 miles from the mouth of the Raisin River. The third area extended upward 3 to 4 miles from the Michigan-Ohio State line near Toledo. Most of the remainder of the Michigan waters of Lake Erie had concentrations of soluble phosphate ranging from 0.05 to 0.10 mg/l as phosphate (0.016 to .033 mg/l as phosphorus).


AREA LOCATION MAP
LAKE HURON
PORT HURON
MICHIGAN
LAKE ST CLAIR
DETROIT
WINDSOR
ONTARIO
LAKE ERIE
TOLEDO
HURON RIVER
POINTE MOUILLEE
INTERNATIONAL BOUNDARY
0.35
0.20
LEGEND
LESS THAN 0.20 MILLIGRAMS PER LITER
0.20 – 0.35 MILLIGRAMS PER LITER
0.35 – 0.50 MILLIGRAMS PER LITER
GREATER THAN 0.50 MILLIGRAMS PER LITER
Swan Creek
Point Aux Peaux
Stony Creek
Stony Pt
Woodland Beach
BREST BAY
MICHIGAN
Detroit Beach
Sandy Creek
MICHIGAN

9830

0.30—0.50 MILLIGRAMS PER LITER
GREATER THAN 0.50 MILLIGRAMS PER LITER
N
Point Aux Peaux
Stony Creek
Stony Pt
Woodland Beach
BREST BAY
MICHIGAN
Detroit Beach
Sandy Creek
STERLING STATE PARK
0.20
0.35
0.20
OHIO
MICHIGAN
RAISIN RIVER
MONROE
Plum Creek
0.50
La Plaisance Creek
Bolles Harbor
0.35
Otter Creek
Toledo Beach
LAKE ERIE

18837

FIGURE 8-XI

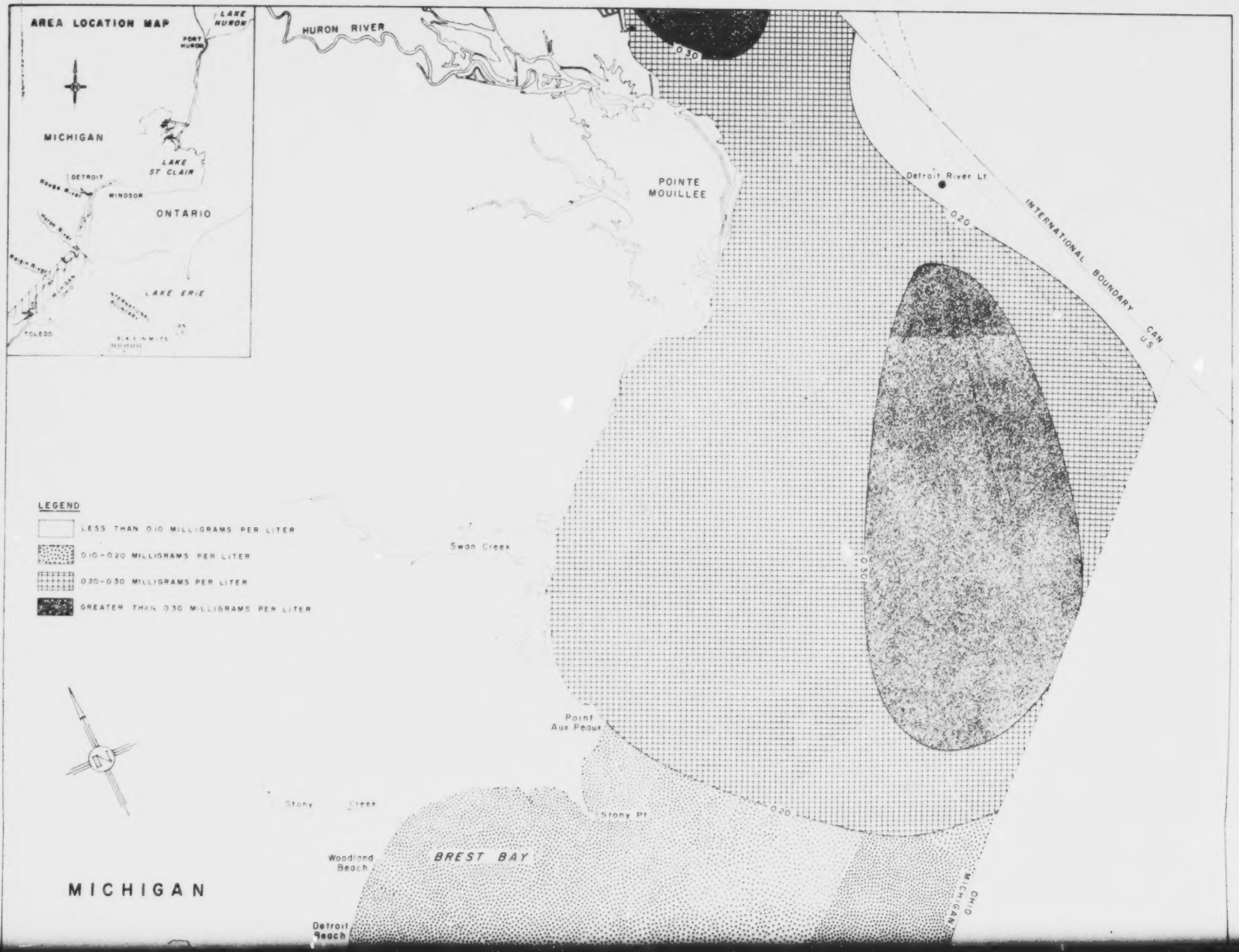
DETROIT RIVER–LAKE ERIE PROJECT

AVERAGE NITRATE-N CONCENTRATIONS

MICHIGAN WATERS OF LAKE ERIE

U.S. DEPARTMENT OF HEALTH, EDUCATION, AND WELFARE
PUBLIC HEALTH SERVICE
REGION V GROSSE ILE, MICHIGAN

283C


AREA LOCATION MAP
LAKE HURON
PORT HURON
MICHIGAN
LAKE ST CLAIR
DETROIT
WINDSOR
ONTARIO
LAKE ERIE
TOLEDO
HURON RIVER
POINTE MOUILLEE
Detroit River Lt
INTERNATIONAL BOUNDARY
CAN
US
0.30
0.20
LEGEND
LESS THAN 0.10 MILLIGRAMS PER LITER
0.10-0.20 MILLIGRAMS PER LITER
0.20-0.30 MILLIGRAMS PER LITER
GREATER THAN 0.30 MILLIGRAMS PER LITER
Swan Creek
Point Aux Peaux
Stony Pt
Stony Creek
Woodland Beach
BREST BAY
Detroit Beach
MICHIGAN
OHIO
MICHIGAN

2836

GREATER THAN 0.30 MILLIGRAMS PER LITER
N
MICHIGAN
Point Aux Peaux
Stony Creek
Stony Pt
0.20
Woodland Beach
BREST BAY
Detroit Beach
Sandy Creek
STERLING STATE PARK
OHIO
MICHIGAN
RAISIN RIVER
MONROE
0.30
0.20
0.10
Plum Creek
La Plaisance Creek
Bolles Harbor
Otter Creek
Toledo Beach
LAKE ERIE

383 b

FIGURE 6-VI

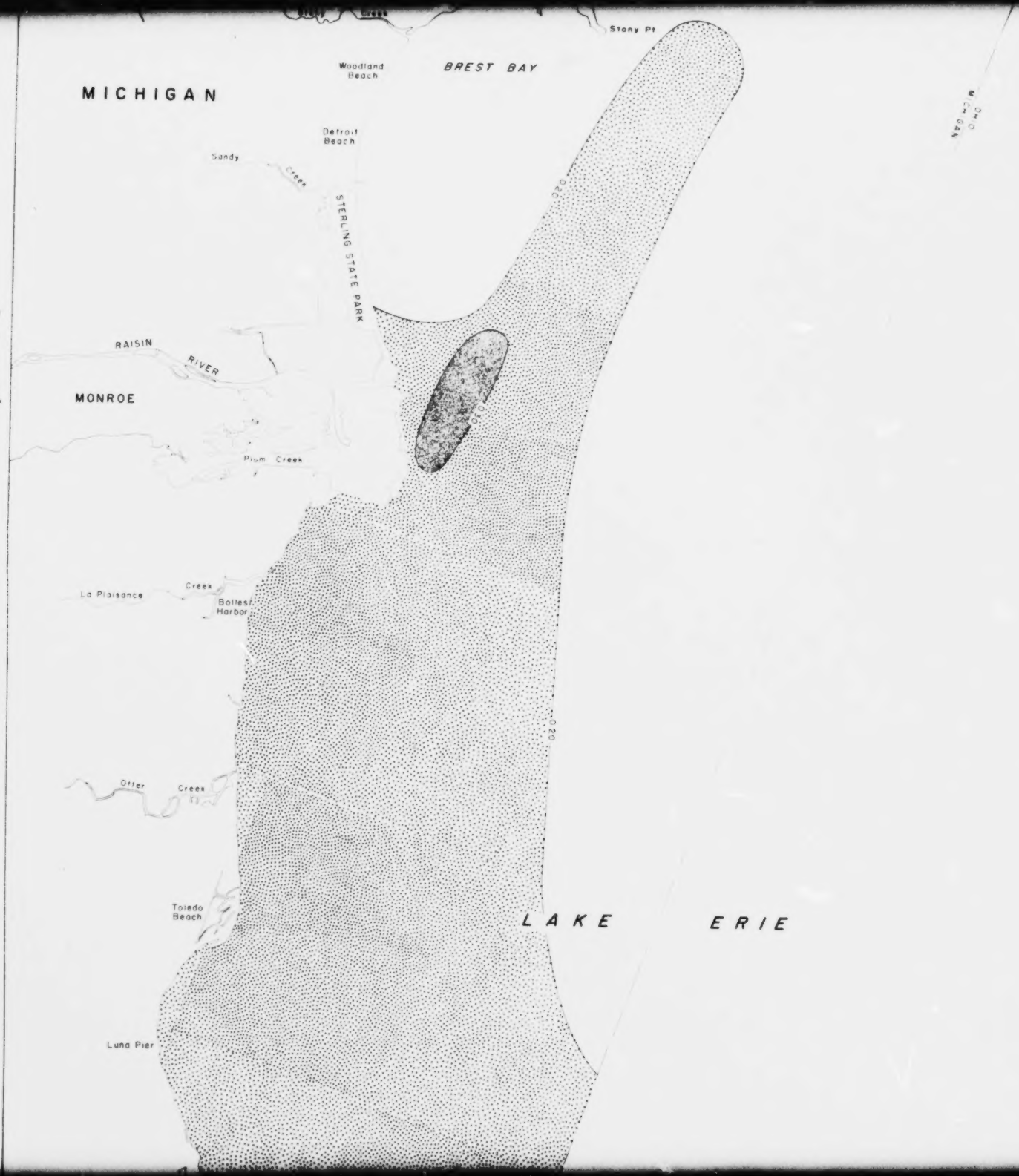
DETROIT RIVER-LAKE ERIE PROJECT

AVERAGE AMMONIA-N CONCENTRATIONS

MICHIGAN WATERS OF LAKE ERIE

U.S. DEPARTMENT OF HEALTH, EDUCATION, AND WELFARE
PUBLIC HEALTH SERVICE
REGION V GROSSE ILE, MICHIGAN

283f


Stony Pt
Woodland Beach
BREST BAY
MICHIGAN
Detroit Beach
Sandy Creek
STERLING STATE PARK
0.20
RAISIN RIVER
MONROE
Plum Creek
La Plaisance Creek
Bolles Harbor
0.20
Otter Creek
Toledo Beach
LAKE ERIE
Luna Pier

283 8

FIGURE 7-VI

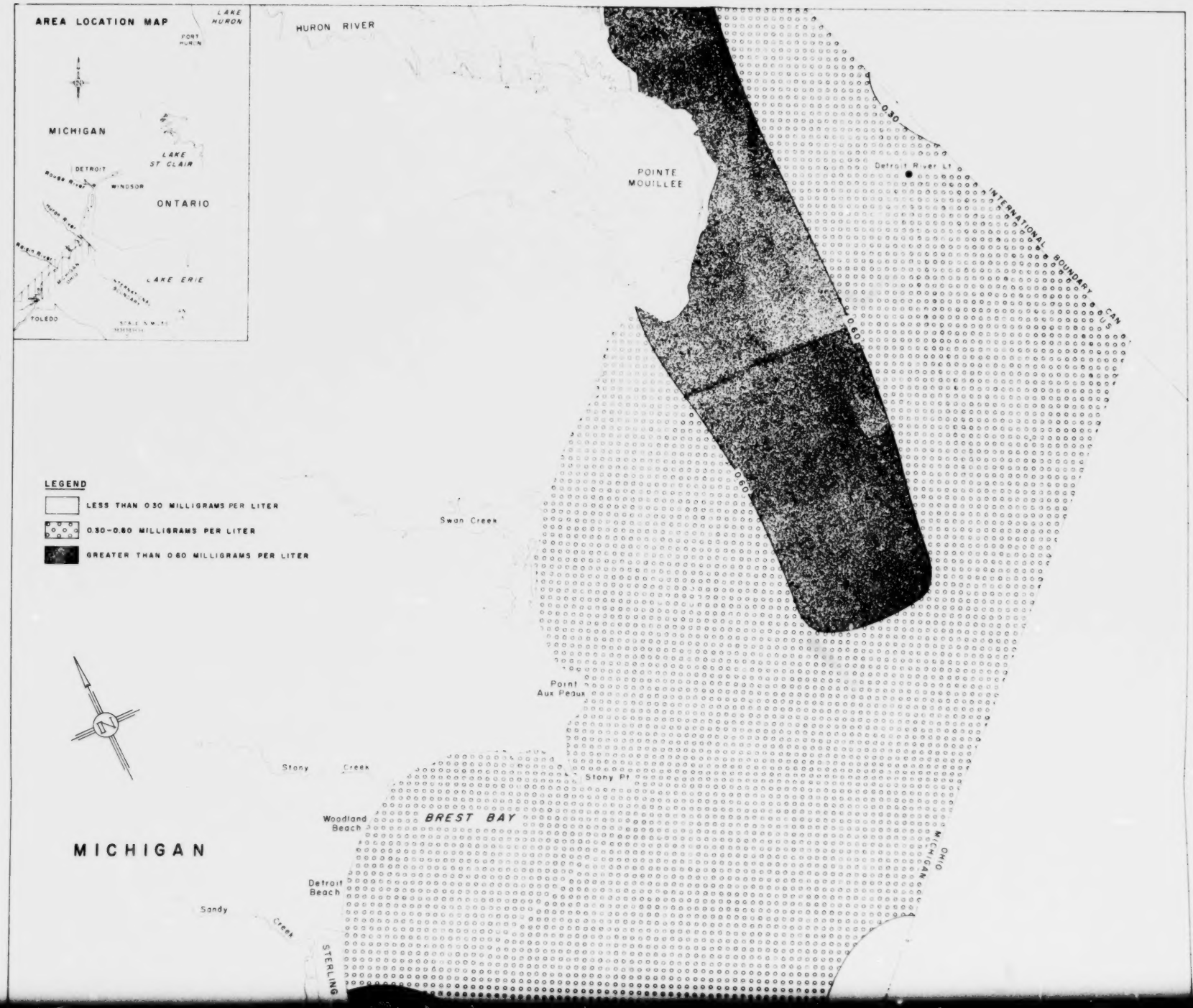
DETROIT RIVER–LAKE ERIE PROJECT

AVERAGE ORGANIC-N CONCENTRATIONS

MICHIGAN WATERS OF LAKE ERIE

U.S. DEPARTMENT OF HEALTH, EDUCATION, AND WELFARE
PUBLIC HEALTH SERVICE
REGION V GROSSE ILE, MICHIGAN

283 i


AREA LOCATION MAP
LAKE HURON
FORT HURON
MICHIGAN
LAKE ST CLAIR
DETROIT
WINDSOR
ONTARIO
LAKE ERIE
TOLEDO
HURON RIVER
POINTE MOUILLEE
Detroit River Lt
INTERNATIONAL BOUNDARY
CAN
U.S.
0.30
0.60
LEGEND
LESS THAN 0.30 MILLIGRAMS PER LITER
0.30-0.60 MILLIGRAMS PER LITER
GREATER THAN 0.60 MILLIGRAMS PER LITER
Swan Creek
Point Aux Peaux
Stony Creek
Stony Pt
Woodland Beach
BREST BAY
MICHIGAN
Detroit Beach
Sandy Creek
STERLING
OHIO
MICHIGAN

283 f

N
Stony Creek
Stony Pt
Woodland Beach
BREST BAY
MICHIGAN
Detroit Beach
Sandy Creek
STERLING STATE PARK
RAISIN RIVER
MONROE
Plum Creek
La Plaisance Creek
Bolles Harbor
Otter Creek
Toledo Beach
Luna Pier
LAKE ERIE
0.60
0.30
0.30

283 8

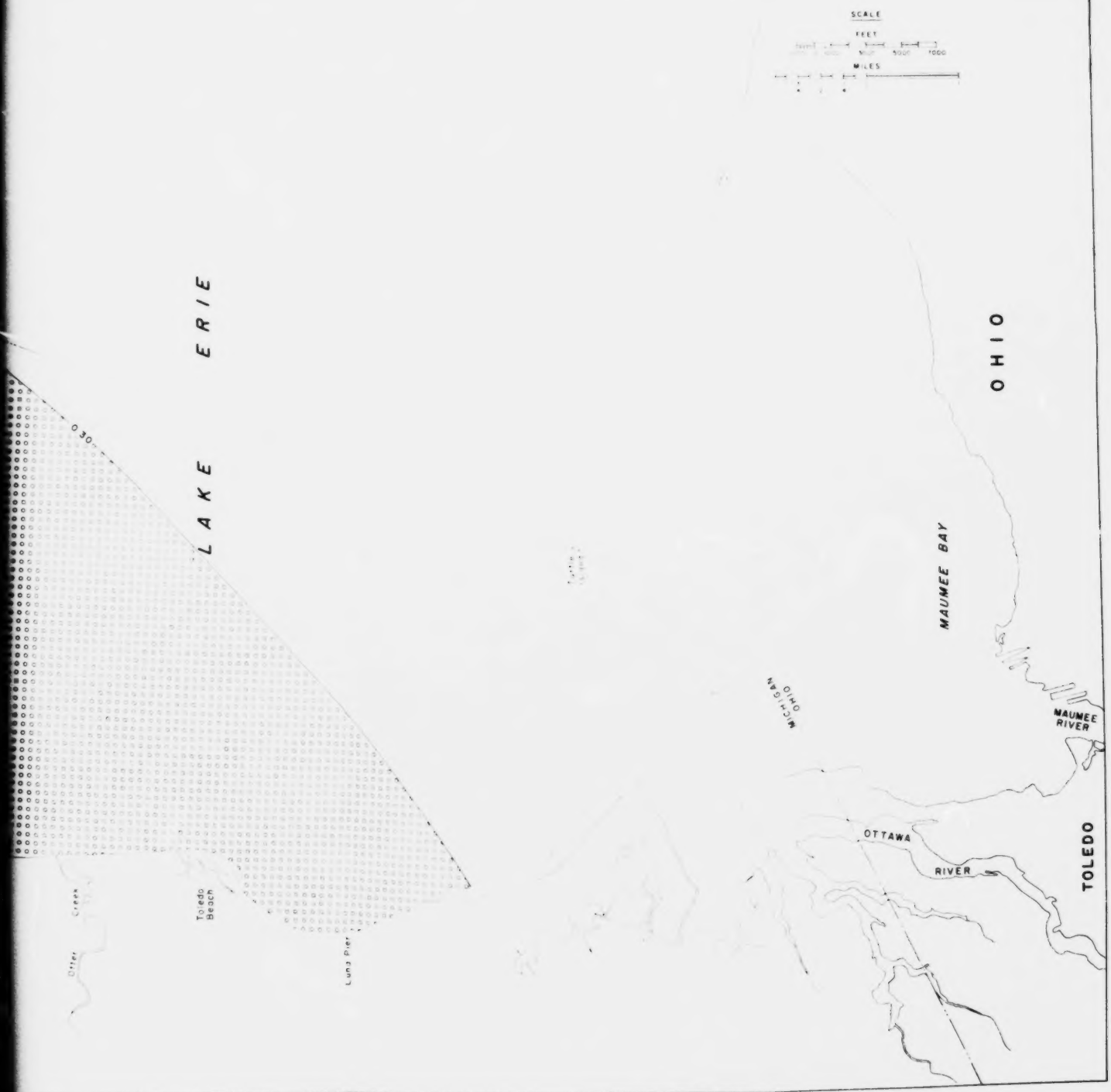
FIGURE 8-XI

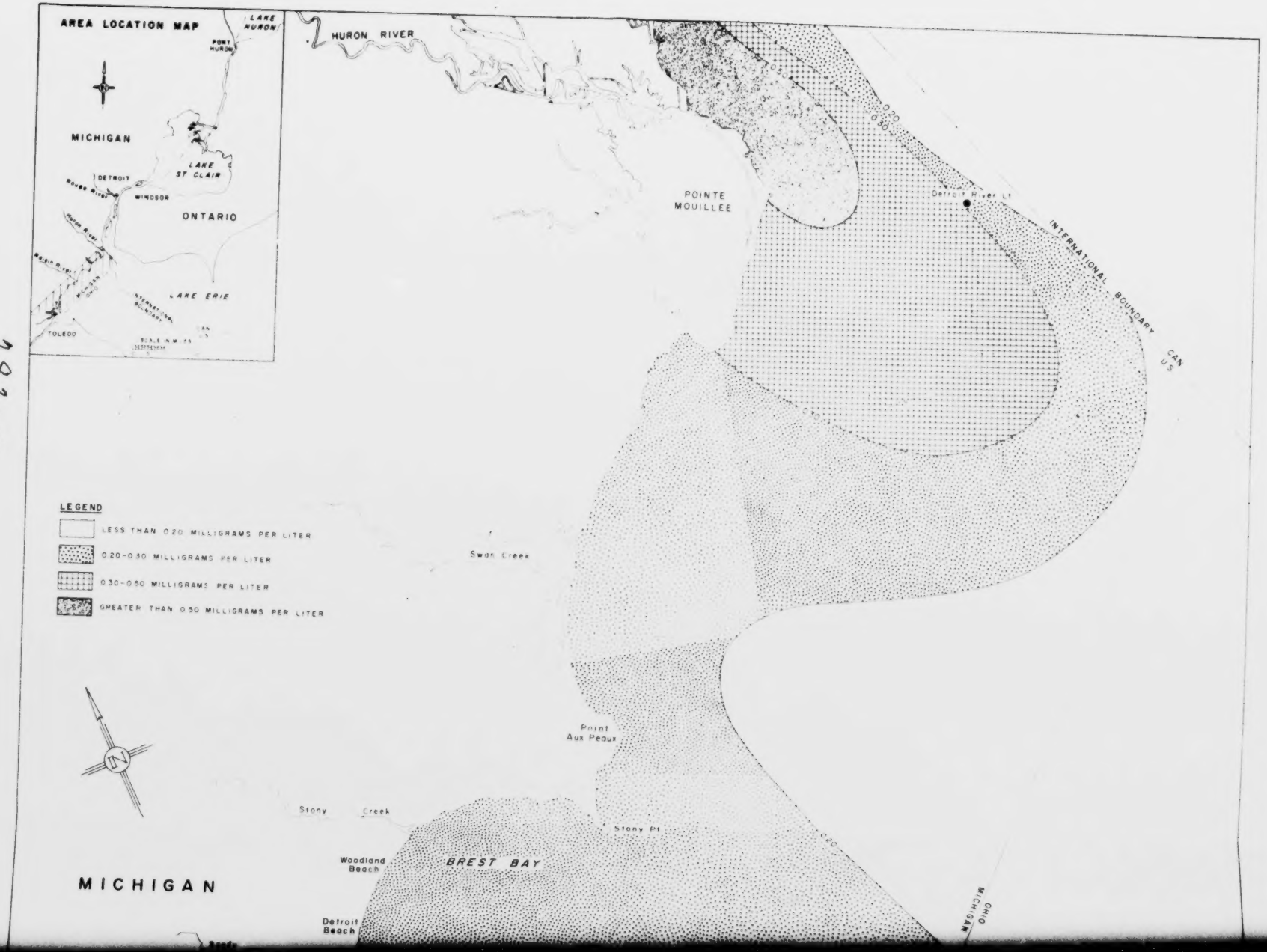
DETROIT RIVER-LAKE ERIE PROJECT

AVERAGE INORGANIC-N CONCENTRATIONS

MICHIGAN WATERS OF LAKE ERIE

U.S. DEPARTMENT OF HEALTH, EDUCATION, AND WELFARE
PUBLIC HEALTH SERVICE
REGION V GROSSE ILE, MICHIGAN




AREA LOCATION MAP
LAKE HURON
PORT HURON
MICHIGAN
DETROIT
WINDSOR
LAKE ST CLAIR
ONTARIO
LAKE ERIE
TOLEDO
HURON RIVER
POINTE MOUILLEE
Detroit River Lt
INTERNATIONAL BOUNDARY
CAN
US
0.20
0.30
LEGEND
LESS THAN 0.20 MILLIGRAMS PER LITER
0.20-0.30 MILLIGRAMS PER LITER
0.30-0.50 MILLIGRAMS PER LITER
GREATER THAN 0.50 MILLIGRAMS PER LITER
Swan Creek
Point Aux Peaux
Stony Creek
Stony Pt
Woodland Beach
BREST BAY
Detroit Beach
MICHIGAN
OHIO
MICHIGAN

283 mn

GREATER THAN 0.50 MILLIGRAMS PER LITER
N
Point Aux Peaux
Stony Creek
Stony Pt
Woodland Beach
BREST BAY
MICHIGAN
OHIO
Detroit Beach
Sandy Creek
STERLING STATE PARK
0.20
RAISIN RIVER
0.30
MONROE
Plum Creek
La Plaisance Creek
Bolles Harbor
Otter Creek
0.20
Toledo Beach
LAKE ERIE

283 cu

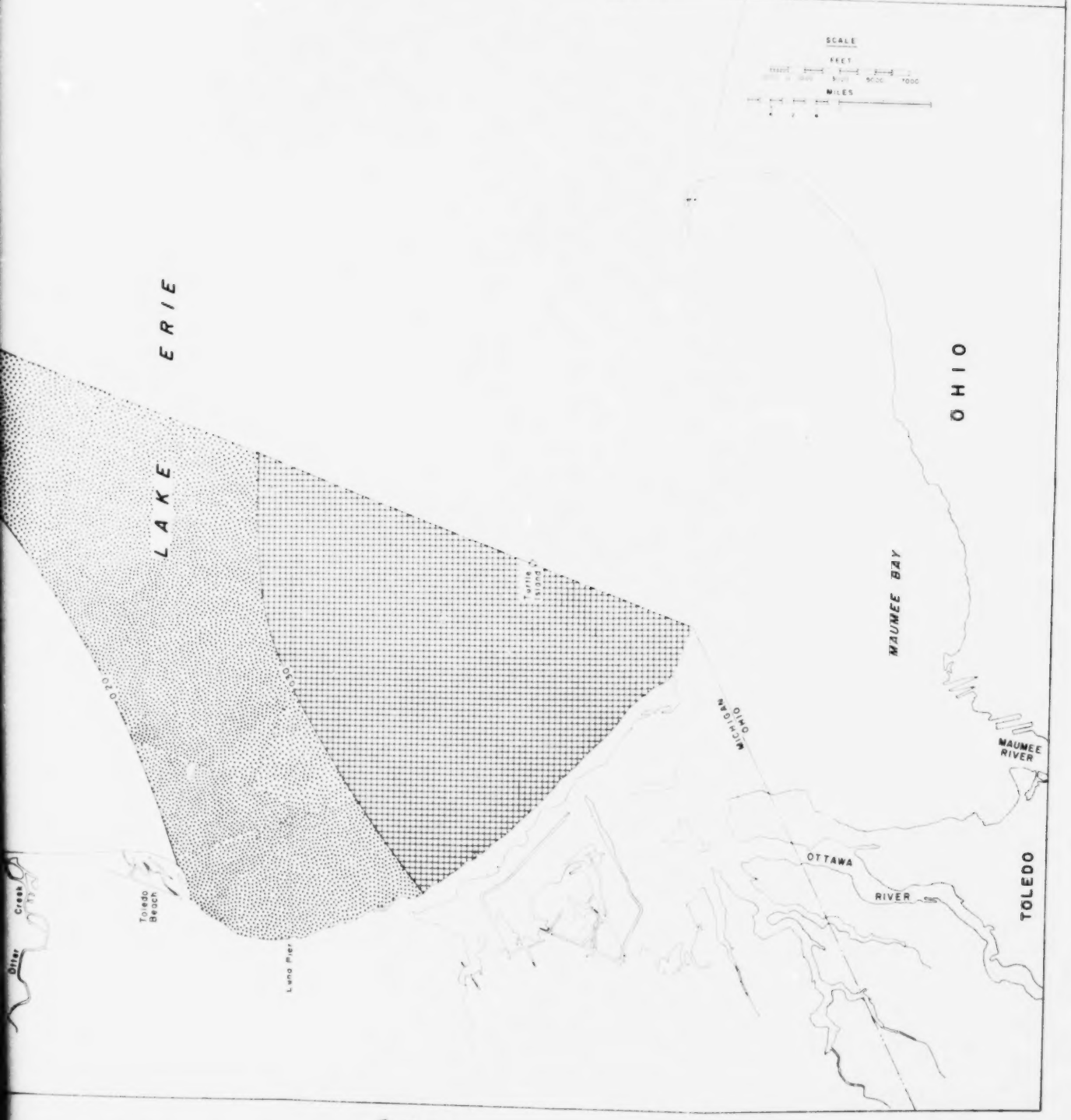
FIGURE 9-VI

DETROIT RIVER–LAKE ERIE PROJECT

AVERAGE TOTAL PHOSPHATE CONCENTRATIONS

MICHIGAN WATERS OF LAKE ERIE

U.S. DEPARTMENT OF HEALTH, EDUCATION, AND WELFARE
PUBLIC HEALTH SERVICE
REGION V GROSSE ILE, MICHIGAN



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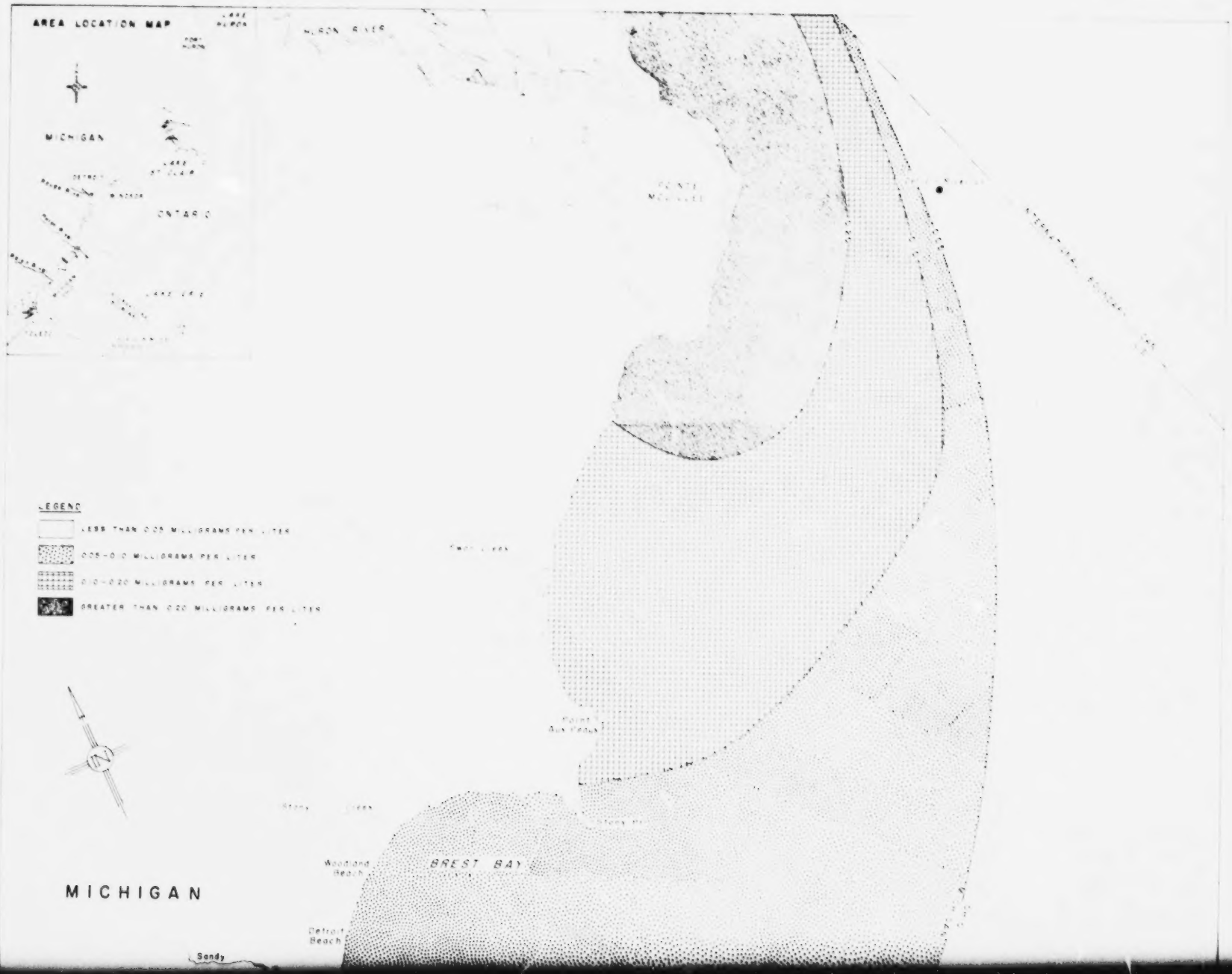
AREA LOCATION MAP
MICHIGAN
ONTARIO
LEGEND
LESS THAN 0.05 MILLIGRAMS PER LITER
0.05-0.10 MILLIGRAMS PER LITER
0.10-0.20 MILLIGRAMS PER LITER
GREATER THAN 0.20 MILLIGRAMS PER LITER
N
Point Aux Peaux
Woodland Beach
BREST BAY
Detroit Beach
Sandy
MICHIGAN

283 p

Point Aux Peaux
Story Creek
Story Pt.
Woodland Beach
BREST BAY
MICHIGAN
Detroit Beach
Sandy Creek
STERLING STATE PARK
RAISIN RIVER
MONROE
Plum Creek
La Plaisance Creek
Bolles Harbor
Otter Creek
Toledo Beach
LAKE ERIE

2838

FIGURE 10-VI

DETROIT RIVER–LAKE ERIE PROJECT

AVERAGE SOLUBLE PHOSPHATE CONCENTRATIONS

MICHIGAN WATERS OF LAKE ERIE

U.S. DEPARTMENT OF HEALTH, EDUCATION, AND WELFARE
PUBLIC HEALTH SERVICE
REGION V GROSSE ILE, MICHIGAN

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Alkalinity

Average alkalinity was very constant throughout the Michigan waters of Lake Erie, ranging from 78 to 86 mg/l. One exception was the concentration at Station L9 of 119 mg/l, with no apparent explanation other than one very high count distorting the average. Alkalinity concentrations at Lake Erie bathing beaches were also consistent and in the same range (76-93 mg/l). Tributary alkalinity concentrations were generally much higher, ranging from 106 mg/l in Swan Creek to 221 mg/l in Plum Creek.

Alkalinity in Michigan Lake Erie was well within a range suitable for all water uses.

Biological

Microscopic Plants and Animals

Waters of the Lake in the study area in contrast to River waters, were found to be rich in plankton, with counts as high as 22,425/ml. The Lake area nearest the shore supported especially dense populations of plant and animal plankters. Plankton was primarily responsible for the observable turbidity of much of the Michigan waters of the Lake.

Collections near the mouth of the Detroit River had phytoplankton counts throughout the season 4 to 7 times lower than those of the Lake, reflecting the plankton-poor water masses passing from the Detroit River and heading eastward into other waters of Lake Erie. Density levels in general increased with distance from the Detroit River mouth. Average values for the whole season were 2,500 organisms/ml for the outshore locations and 4,200 organisms/ml for the inshore stations (see Table 7-VI).

The abundance of phytoplankton observed in the Michigan waters of Lake Erie indicates that its capacity to produce plankton is among the highest in the Great Lakes. The heavy crops of algae observed at the inshore stations near Stony Point and Brest Bay could not be maintained throughout the summer season without an adequate supply of inorganic nitrogen and soluble phosphates. Measurements showed inorganic nitrogen and soluble phosphates reported as phosphorus at 0.55 mg/l and 0.036 mg/l, respectively, levels characteristic of organically enriched waters. The nutrient levels at the beginning of the spring growing season required to produce nuisance blooms are only 0.30 mg/l for inorganic nitrogen and 0.015 mg/l for soluble phosphates reported as phosphorus.

The shallowness of the western basin of Lake Erie, coupled with wind and current action, bring about almost uniform vertical distribution of temperature and nutrients, which creates an optimal environment for growth and reproduction of plankters. Atmospheric and photosynthetic oxygen is thoroughly mixed throughout the water mass, so that there is no anaerobic organic decomposition near the bottom. High mid-summer temperatures of 24°C increase the rate of decomposition of protein materials and convert nitrogen into the form needed for growth of algae. Phosphorus, bound in the cell material of dead and decaying algae and other organic material, is released in the form of soluble phosphates and a portion recycled as a plant nutrient.

In the Brest Bay area, where the nutrient supply is rich and the algae counts highest, the phosphates and nitrates are recirculated in the water mass by the clockwise currents. The addition of more nutrients gradually increases the concentration. At times of bloom low levels of nitrates were observed, but this can be explained by the known tendency of phytoplankton to take up nutrients in excess of actual needs.

A considerable portion of the nutrient supply for maintaining the observed phytoplankton abundance in Brest Bay originates from the discharge of inadequately treated domestic wastes and the paper mill wastes to the Raisin River at Monroe. Nutrient measurements substantiate this assumption, as the phosphate and nitrate levels observed in the Raisin River were 0.4 mg/l and 0.6 mg/l, respectively.

Other symptoms of heavy organic enrichment at the inshore stations were the sewage-tolerant species of green and blue-green algae, and the diatoms characteristic of highly eutrophic bodies of standing water. These blooms were concentrated in Brest Bay and at the station above Stony Point close to the City of Monroe's water intake. (Taste and odor-producing algae have caused trouble at the City of Monroe's water treatment plant in the past. The intake was moved to its present location in 1950 to obtain waters less prone to tastes and odors.)

The filamentous green alga, Cladophora, and the filamentous slime bacterium sphaerotilus, mentioned earlier as usually associated with nutrient-enriched waters,

were also found at most stations in Lake Erie. Heavy growths of alga were found along the beaches near Bolles Harbor, and in the Brest Bay area, further indicating the polluted condition of these waters and pointing to sources of waste in the Monroe-Raisin River area.

Bottom Organisms

In Lake Erie, a study of the bottom animals revealed particularly polluted areas adjacent to the Raisin River and Sterling State Park (Figure 12-VI, Table 8-VI), and also at the mouth of the Detroit River, extending in the shape of a fan out into the Lake. The clustering of these zones close to the mouths of the Detroit and Raisin Rivers points to the greatest sources of pollution. In between the two polluted areas, associations of bottom forms containing sensitive, intermediate, and tolerant specimens indicate that the two general areas of pollution are independent of each other.

Samples from the Detroit River below sources of pollution and from the Lake did not contain a single burrowing mayfly. Among the causative factors involved in the disappearance of this important fish food organism are changes in the Lake floor sediments themselves. Ooze or flocculent sludge and oil laid down by pollution from Detroit and the Monroe area have replaced the more desirable habitats that once supported mayflies and other fish-food organisms.

TABLE 7-VI. ABUNDANCE OF PHYTOPLANKTON - LAKE ERIE STATIONS, 1963

Values in Number of Organisms per Milliliter

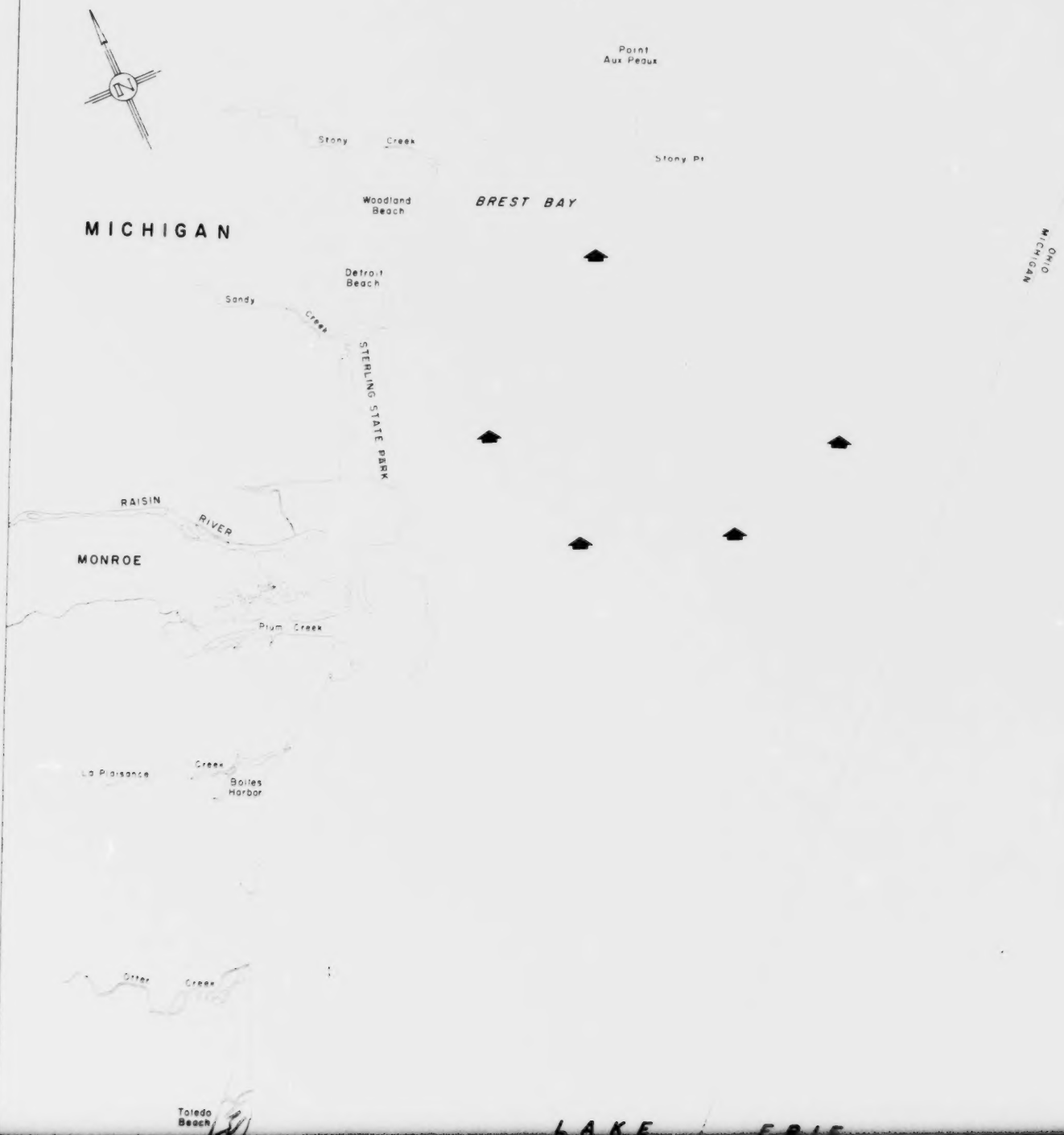
Station	April 18	May 9	*June 3	July 5	August 6	Sept. 4	*Oct. 3	*Oct. 10	Nov. 4	Nov. 27	Mean
	Date of Collection										
(Outshore)											
2	1775	925	900	950	525	125	350	625	550	275	700
5	2050	7125	2750	1025	525	100	275	1250	1900	2850	1985
10	4450	6075	7775	3625	1225	575	2100	1200	1675	3600	3230
15	8350	3950	5825	3750	1575	725	1800	775	2525	3525	3280
17	5825	7225	6450	3925	1375	750	2500	1550	1250	1650	3250
Mean	4490	5060	4740	2655	1045	455	1405	1080	1580	2380	2489
(Inshore)											
4	22425	6450	12600	5675	875	225	250	1075	3200	225	5300
8	7825	4845	3575	10325	1600	1000	300	500	2875	2950	3580
12	8975	4250	4800	4500	1900	1100	5025	1125	6025	5175	4288
24	4100	5325	4500	6050	5150	1800	4525	1800	3950	4125	4133
28	4800	4650	7875	5175	4225	1500	3750	1650	2625	5350	4150
14	5525	7200	9250	6775	2550	1625	5875	1450	3800	2900	4695
20	5425	8725	3600	2225	1850	2075	2000	1450	950	4400	3272
Mean	8439	5921	6600	5818	2593	1332	3104	1293	3357	3589	4205

* Variations from date of collection shown:

June 3 - Station 2 on May 20; 4, 5, 8 on May 29; 17, 20 on June 4.
October 3 - Stations 2, 4, 5, 8 on September 30.
October 10 - Stations 12, 15, 28 on October 11; Stations 2, 4, 5, 8 on October 14

AREA LOCATION MAP
LAKE HURON
PORT HURON
MICHIGAN
LAKE ST CLAIR
DETROIT
Rouge River
WINDSOR
ONTARIO
Huron River
Raisin River
MICHIGAN
OHIO
INTERNATIONAL BOUNDARY
LAKE ERIE
TOLEDO
SCALE IN MILES
HURON RIVER
POINTE MOUILLEE
Detroit River Lt
INTERNATIONAL BOUNDARY
CAN
US
LEGEND
AREA WHERE FILAMENTOUS SEWAGE BACTERIA WERE OBSERVED
Swan Creek
Point Aux Peaux
Stony Creek
Stony Pt
Woodland Beach
BREST BAY
MICHIGAN
Detroit Beach
Sandy
OHIO
MICHIGAN

2876


N
Point
Aux Peaux
Stony
Creek
Stony Pt
Woodland
Beach
BREST BAY
MICHIGAN
OHIO
MICHIGAN
Detroit
Beach
Sandy
Creek
STERLING STATE PARK
RAISIN
RIVER
MONROE
Plum Creek
La Plaisance
Creek
Bolles
Harbor
Otter
Creek
Toledo
Beach
LAKE
ERIE

2 482

FIGURE II-VI

DETROIT RIVER-LAKE ERIE PROJECT

DISTRIBUTION OF FILAMENTOUS SEWAGE BACTERIA

MICHIGAN WATERS OF LAKE ERIE

U.S. DEPARTMENT OF HEALTH, EDUCATION, AND WELFARE
PUBLIC HEALTH SERVICE
REGION V GROSSE ILE, MICHIGAN

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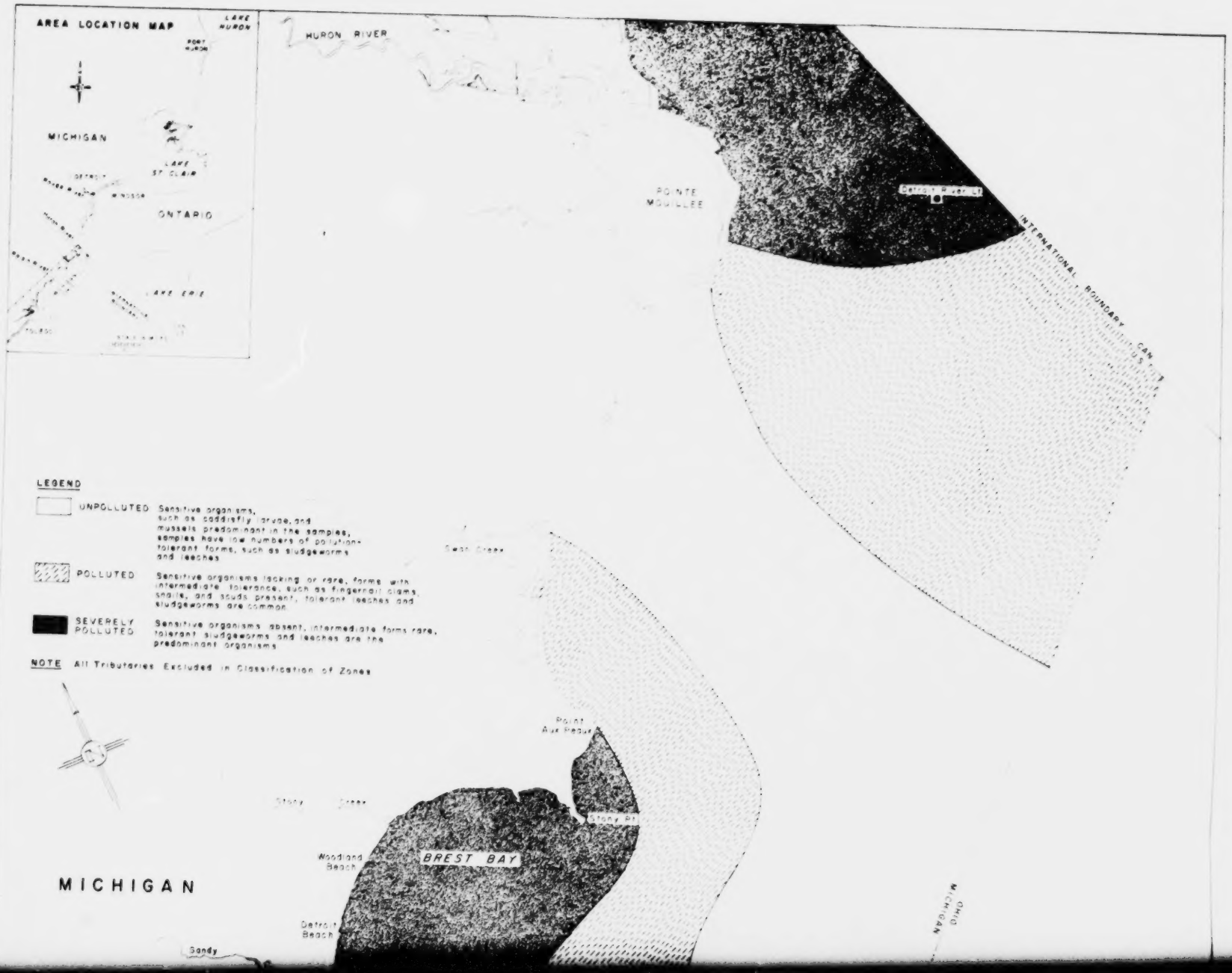
AREA LOCATION MAP
LAKE HURON
PORT HURON
MICHIGAN
LAKE ST. CLAIR
DETROIT
WINDSOR
ONTARIO
LAKE ERIE
TOLEDO
HURON RIVER
POINTE MOUILLEE
Detroit River
INTERNATIONAL BOUNDARY
CAN.
U.S.
LEGEND
UNPOLLUTED Sensitive organisms, such as caddisfly larvae, and mussels predominant in the samples, samples have low numbers of pollution-tolerant forms, such as sludgeworms and leeches
POLLUTED Sensitive organisms lacking or rare, forms with intermediate tolerance, such as fingernail clams, snails, and scuds present, tolerant leeches and sludgeworms are common
SEVERELY POLLUTED Sensitive organisms absent, intermediate forms rare, tolerant sludgeworms and leeches are the predominant organisms
NOTE All Tributaries Excluded in Classification of Zones
Point Aux Peaux
Stony Pt.
Stony Creek
Woodland Beach
BREST BAY
MICHIGAN
Detroit Beach
Sandy
OHIO
MICHIGAN

2874

MICHIGAN
Detroit Beach
Sandy
Creek
STERLING STATE PARK
RAISIN
RIVER
MONROE
Plum Creek
La Plaisance
Creek
Bolles Harbor
Otter
Creek
Toledo Beach
Luna Pier
LAKE
ERIE
OHIO
MICHIGAN

287e

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FIGURE 12-VI

DETROIT RIVER-LAKE ERIE PROJECT

AREAS OF POLLUTION AS INDICATED BY BOTTOM ORGANISM ASSOCIATIONS

MICHIGAN WATERS OF LAKE ERIE

U.S. DEPARTMENT OF HEALTH, EDUCATION, AND WELFARE
PUBLIC HEALTH SERVICE
REGION V GROSSE ILE, MICHIGAN

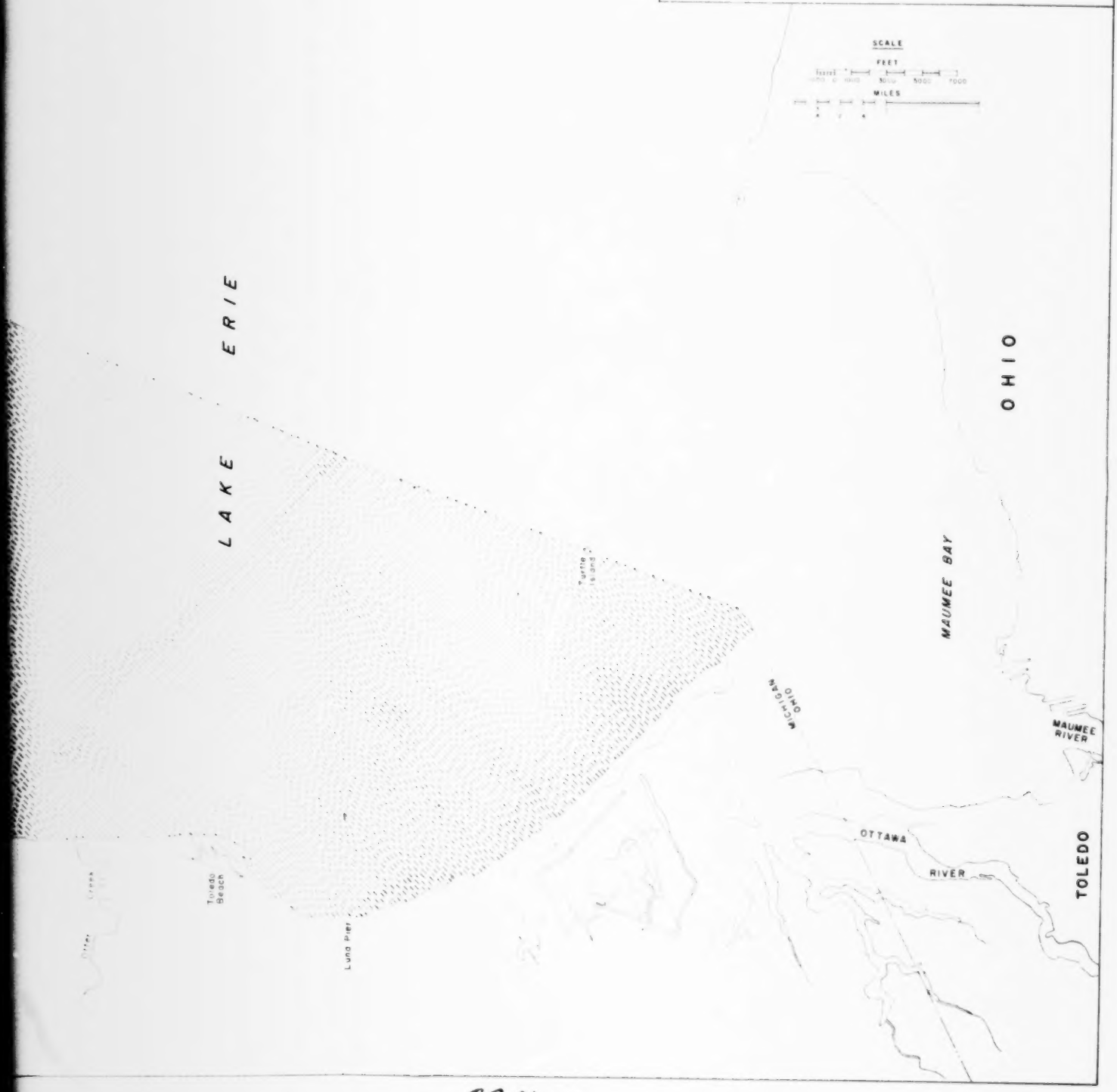

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TABLE 8-VI

SUMMARY OF BOTTOM ORGANISM DATA, LAKE ERIE
MEAN NUMBER PER SQUARE FOOT OF BOTTOM

	SENSITIVE FORMS		INTERMEDIATE FORMS				TOLERANT FORMS	
Station	Caddisfly Larvae	Mussels	Snails	Fingernail Clams	Scuds	Midge Larvae	Leeches	Sludgeworms
L-2	-	-	-	-	-	-	1	5837
L-4	-	-	1	-	-	-	-	22
L-5	-	-	-	3	-	-	-	67
L-6	-	-	1	2	-	1	2	70
L-7	-	1	3	15	-	10	3	16
L-8	-	-	3	1	-	2	1	7
L-9	-	1	2	7	-	1	1	1
L-10	-	3	2	2	-	1	1	1
L-11	-	1	5	1	-	2	1	1
L-12	-	1	1	1	-	-	2	1
L-14(1)	-	-	-	-	-	-	1	1
L-15	-	1	1	5	-	1	2	1
L-17	-	1	1	1	-	1	3	2
L-20	3	1	4	1	-	-	3	36
L-21	-	-	4	1	-	-	1	11
L-22	-	1	1	-	-	-	1	41
L-23	1	-	-	-	-	-	-	19
L-24	1	-	-	-	-	1	-	16
L-25	-	1	1	-	-	1	1	1
L-26	1	-	-	-	-	3	-	207
L-27	-	-	-	-	-	-	1	36
L-28	-	-	-	-	-	-	3	51
L-32(1)	-	-	-	-	-	-	1	45
L-41(2)	-	-	-	-	-	-	2	4
T-80	-	-	-	-	-	-	-	9

(1) No macro-bottom organisms, Fall Survey.
(2) No macro-bottom organisms, Spring Survey.

Municipal

In addition to studying the operating records of sewage treatment plants (see Figures 11-I and 14-I) in the area studied by the Project, two 4-day surveys were made of the Monroe Sewage Treatment Plant in cooperation with the Michigan Department of Health. Waste flows were measured, hourly bacteriological samples and 12-hour composite chemical, biochemical, and physical samples collected, and the results analyzed in the Project laboratory. Table 9-VI summarizes the results of the two surveys and Table 10-VI lists waste loadings and observed treatment efficiency of the plant. The Monroe Plant, with an outfall located near the mouth of the Raisin River, was the only municipal plant whose direct effect on water quality in Lake Erie could be demonstrated.

The two surveys revealed an influent fairly typical of a weak domestic waste. Exceptions to this general observation included high concentrations of soluble and total phosphates (20 and 40 mg/l respectively), and high concentrations of certain toxic metals including copper, zinc and lead.

Plant efficiency as measured by removal of suspended solids (62 percent) and BOD (59 percent) was very good for a primary sewage treatment plant. Bacterial control was effective during the first survey when the effluent was chlorinated but poor during the second survey when it was not. Plant operating records revealed that similar degrees of efficiency were maintained on a long-term basis. Although chlorination was practiced only during summer months, the results during the 1963 season compared favorable with those found during the first survey. In general, the plant was excellently operated, and its personnel are to be commended.

Nutrient concentrations in the effluent in the form of ammonia and phosphate were high, at 8.3 mg/l and 21 mg/l respectively. Oil and grease concentrations were erratic, averaging 7 mg/l during the first survey and 36 mg/l during the second. This variance appeared to be caused primarily by differences in the plant influent, since very little oil was being removed during treatment. Phenol concentrations in the effluent were high, at 47 ug/l.

Study of effluent loadings, shown in Table 10-VI, revealed that this plant contributed daily 52 gallons of oil and grease, 214 pounds of nitrogen compounds, over 600 pounds of phosphates, 1,180 pounds of suspended solids, and an oxygen demand equivalent to the raw sewage of a population of 8,100 to the Raisin River.

The table below lists the loadings of iron, oil, phenols and suspended solids which would result if International Joint Commission effluent limitations, including a suspended solids limitation of 35 mg/l, were met at the Monroe Plant.

Pollutant	Present Loading	Loading after Reduction	Reduction %
Oil and Grease	52 gallons/ day	31 gallons/day	40
Phenols	0.97 pounds/day	0.47 pounds/day	51
Iron	31 lbs. /day	31 lbs. /day	0
Suspended Solids	1,180 lbs. /day	856 lbs. /day	27

Survey No.	Dates of Survey	Avg. Flow MGD	Type of Sample	Avg. Susp. Solids mg/l	Avg. Sett. Solids mg/l	Avg. BOD mg/l	Avg. COD mg/l	Avg. Phenols µg/l	Avg. Oil & Grease mg/l	Avg. NH_3 N mg/l	Avg. Org. N mg/l	A N
1	June 9 through June 12 1963	3.95	Influent	98	68	105	191	31	6	2.0	3.2	
			Effluent	37	13	43	158	30	7	1.9	1.5	
2	Nov. 4 through Nov. 7 1963	1.92	Influent	188	116	-	-	64	40	20.7	3.1	
			Effluent	69	21	-	-	65	36	14.7	6.6	
Avg. of 1 & 2	-	2.93	Influent	143	92	105	191	47	23	11.3	3.1	
			Effluent	53	17	43	158	47	21	8.3	4.0	

Survey No.	Dates of Survey	Avg. Flow MGD	Type of Sample	Total Coliform Organisms per 100 ml			Fecal Colifo per	
				maximum	minimum	geom. mean	maximum	mi
1	June 9 through June 12 1963	3.95	Influent	38,000,000	6,100,000	11,500,000	24,600,000	2,
			Effluent	82,000	L 10	105	28,000	
2	Nov. 4 through Nov. 7 1963	1.92	Influent	290,000,000	31,000,000	91,700,000	73,000,000	6,
			Effluent	110,000,000	13,000,000	53,800,000	61,000,000	3,
Avg. of 1 & 2	-	2.93	Influent	164,000,000	18,500,000	51,600,000	48,800,000	4,
			Effluent		-	-	-	

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TABL

Avg. Phenols µg/l	Avg. Oil & Grease mg/l	Avg. NH_3 N mg/l	Avg. Org. N mg/l	Avg. NO_3 N mg/l	Avg. NO_2 N mg/l	Avg. Sol. PO_4 mg/l	Avg. Tot. PO_4 mg/l	Avg. Cl mg/l	pH Range units	Avg. ABS mg/l	Avg. Iron mg/l	Avg. Cu mg/l	Avg. Cd mg/l	Avg. Ni mg/l	Avg. Zn mg/l	Avg. Pb mg/l	Av Cl mg
31	6	2.0	3.2	-	.011	20	-	73	7.0-7.4	3.93	1.48	0.07	-	0.01	0.06	0.13	
30	7	1.9	1.5	-	-	21	-	83	6.8-7.4	5.45	0.93	-	-	0.01	0.05	0.09	
64	40	20.7	3.1	.084	.005	-	40	-	6.6-7.0	-	-	-	-	-	-	-	
65	36	14.7	6.6	.068	.007	-	40	-	6.8-7.0	-	-	-	-	-	-	-	
47	23	11.3	3.1	.084	.008	20	40	73	6.6-7.4	3.93	1.48	0.07	-	0.01	0.06	0.13	
47	21	8.3	4.0	.068	.007	21	40	83	6.8-7.4	5.45	0.93	-	-	0.01	0.05	0.09	

s	Fecal Coliform Organisms per 100 ml			Fecal Streptococci Organisms per 100 ml		
om. mean	maximum	minimum	geom. mean	maximum	minimum	geom. mean
,500,000	24,600,000	2,960,000	6,300,000	680,000	196,000	288,000
105	28,000	L 10	-	720	L 10	29
700,000	73,000,000	6,200,000	24,500,000	1,400,000	470,000	893,000
800,000	61,000,000	3,900,000	19,200,000	1,100,000	260,000	693,000
600,000	48,800,000	4,600,000	15,400,000	1,040,000	330,000	590,000
-	-	-	-	-	-	-

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TABLE 9-VI. SUMMARY OF RESULTS OF MONROE SEWAGE TREATMENT PLANT SURVEY

	Avg. Iron	Avg. Cu	Avg. Cd	Avg. Ni	Avg. Zn	Avg. Pb	Avg. CN	Avg. Cl_2 Resid.
	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l
3	1.48	0.07	-	0.01	0.06	0.13	-	-
5	0.93	-	-	0.01	0.05	0.09	-	1.25
-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-
3	1.48	0.07	-	0.01	0.06	0.13	-	-
5	0.93	-	-	0.01	0.05	0.09	-	1.25

ci Organisms ml	
m	geom. mean
000	288,000
10	29
000	893,000
000	693,000
000	590,000
-	-

Survey No.	Dates of Survey	Susp. Solids	Sett. Solids	BOD	BOD P.E.	Phenols	Oil & Grease	NH_3 N	
		lbs/day	lbs/day	lbs/day	people	lbs/day	gallons	lbs/day	l
1	June 9-12	1,250	452	1,380	8,100	0.93	32	47	
2	Nov. 4-7	1,110	345	-	-	1.00	73	215	
Avg.	-	1,180	398	1,330	8,100	0.97	52	131	

Survey No.	Dates of Survey	Total Coliforms	Total Fecal Coliforms	Total Fecal Streptococci
		number	number	number
1	June 9-12	15.7×10^{9}	-	4.3×10^{9}
2	Nov. 4-7	39.1×10^{14}	16.4×10^{14}	50.6×10^{13}
Avg.	-	-	-	-

Survey No.	Date of Survey	Susp. Solids	Sett. Solids	BOD	COD	Phenols	Oil & Grease	Ammo Nitr
		% removal	% removal	% removal	% removal	% removal	% removal	% rem
1	June 9-12	62	81	59	17	3	0	5
2	Nov. 4-7	63	82	-	-	0	10	29
Avg.	-	62	82	59	17	1.5	5	17

Survey No.	Date of Survey	Nickel	Zinc	Lead	Cyanide	Total Coliforms	Fecal Coliform
		% removal	% removal	% removal	% removal	% removal	% remov
1	June 9-12	0	17	31	-	99.99	99.99
2	Nov. 4-7	-	-	-	-	42	88
Avg.	-	0	17	31	-	-	-

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BOD F.E.	Phenols	Oil & Grease	NH_3 N	Org. N	NO_3 N	NO_2 N	Sol. PO_4	Tot. PO_4	Chloride	ABS	Iron
eople	lbs/day	gallons	lbs/day	lbs/day	lbs/day	lbs/day	lbs/day	lbs/day	lbs/day	lbs/day	lbs/day
8,100	0.93	32	47	46	-	-	637	-	2,690	179	31
-	1.00	73	215	119	1.12	0.1	-	682	-	-	-
8,100	0.97	52	131	82	1.12	0.1	637	682	2,690	179	31

s	Total Fecal Streptococci
	number
10^{14}	4.3×10^{9}
	50.6×10^{13}
	-

al	COD	Phenols	Oil & Grease	Ammonia Nitrogen	Organic Nitrogen	Nitrate Nitrogen	Nitrite Nitrogen	Soluble Phosphates	Total Phosphates	Chlorid
	% removal	% removal	% removal	% removal	% removal	% removal	% removal	% removal	% removal	% remov
	17	3	0	5	53	-	-	0	-	0
	-	0	10	29	0	19	0	-	0	-
	17	1.5	5	17	26	19	0	0	0	0

Cyanide	Total Coliforms	Fecal Coliforms	Fecal Streptococci
% removal	% removal	% removal	% removal
-	99.99	99.99	99.99
-	42	22	22
-	-	-	-

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TABLE 10-VI. SUMMARY OF WASTE LOADINGS

MONROE SEWAGE TREATMENT PLANT SURVEY

Chloride	ABS	Iron	Copper	Cadmium	Nickel	Zinc	Lead	Cyanide
lbs/day	lbs/day	lbs/day	lbs/day	lbs/day	lbs/day	lbs/day	lbs/day	lbs/day
2,690	179	31	-	-	0.33	1.65	2.96	-
-	-	-	-	-	-	-	-	-
2,690	179	31	-	-	0.33	1.65	2.96	-

SUMMARY OF TREATMENT EFFICIENCY

MONROE SEWAGE TREATMENT PLANT SURVEY

uble sphates	Total Phosphates	Chlorides	ABS	Iron	Copper	Cadmium
emoval	% removal	% removal	% removal	% removal	% removal	% removal
0	-	0	0	37	-	-
-	0	-	-	-	-	-
0	0	0	0	37	-	-

Industrial

The sources of industrial wastes studied in the lower Raisin River are six plants near Monroe, Michigan. These plants consists of four paper mills, a manufacturer of automobile bumpers and accessories, and a plant producing shock absorbers. The location of these industries is shown on Figure 6-II. Individual grab samples were collected from plant outfalls throughout the Project's duration, and an intensive survey of each industry was performed in cooperation with personnel of Michigan Water Resources Commission. In the computation of waste loadings contributed by each industry, only the increase over values found in the plants' raw water supply was used. Tables 11-VI through 14-VI summarize the results: 11-VI shows average concentrations of selected waste constituents; 12-VI summarizes waste loadings; 13-VI lists the industries and their water use and discharge; 14-VI lists particular discharges considered excessive. In most cases, values found during the intensive surveys were used as reported, but some were modified by grab samples collected from plant effluents by the Public Health Service.

The total waste volume from these six plants is 151 million gallons per day. Another plant, the Consolidated Paper Company--West Side Works, although not operating during the Project, has since resumed operation on a part-time basis. Waste constituents from these sources include large quantities of oxygen-demanding material which deplete the oxygen resources of the Raisin River beyond recovery. The wastes also contain significant quantities of coliform bacteria, oil, toxic metals, cyanides, and suspended and settleable solids.

The industrial wastes which most seriously degrade the water of the Raisin River originate from the four paper mills, where the treatment is in all cases inadequate. The paper plants all provide partial treatment for removal of settleable solids and one provides chemical coagulation in addition. The Ford Motor Company plant maintains extensive treatment facilities for control of the toxic metallic ions and cyanide-bearing wastes. In addition, a small primary sewage treatment plant treats the domestic wastes from the Ford Works. With the exception of the Monroe Auto Equipment Company, all treatment facilities are inadequate to prevent interference with water uses in the Raisin River and subsequently in Lake Erie. The Raisin River itself, primarily due to the paper mill wastes, is in a continuous state of putrefaction and is literally offensive in appearance.

Wastes in the Raisin River eventually reach the waters of western Lake Erie. The paper mill wastes combined far exceed the assimilative capacity of the Raisin River, discharging wastes equal to the oxygen demand of sewage from a population of 225,000. They also contain excessive densities of coliforms, at times exceeding 1,000,000 organisms per 100 ml. These densities are of particular concern because of the Lake Erie bathing beaches at the mouth of the Raisin. The Ford Motor Company discharges 1,075 pounds of cyanides and 4,080 pounds of toxic metals each day and, under summer low-flow conditions, the large discharge from Ford comprises nearly the entire flow in the lower Raisin River. The oil from Ford, although low in concentration due to dilution in the waste canal, is large in quantity--870 gallons/day. These wastes may severely hinder the propagation of aquatic life in the Raisin River and the nearby Lake waters.

Below is a tabulation of the industrial waste loadings in the Raisin River which would result if excessive concentrations of certain constituents were reduced to meet International Joint Commission effluent recommendations and a suspended solids effluent limit of 35 mg/l.

Pollutant	Present Loading	Loadings after Reduction	% Reduction
Iron	35 pounds/day	35 pounds/day	0
Oil	870 gallons/day	870 gallons/day	0
Phenols	22 pounds/day	6 pounds/day	70
Suspended Solids	23,500 pounds/day	7,400 pounds/day	68

TABLE 13-VI. SOURCES OF INDUSTRIAL WASTES - RAISIN RIVER

Industry	Volume (MDG)	Product	Production	Significant Waste Constituents	Waste Treatment or Control
Consolidated Paper Company					
North Side Division	7.5	liner board and corrugated cardboard	435 tons/day	coliform, suspended solids, BOD	sedimentation
South Side Division	7.0	automotive blackboard, boxboard	368 tons/day	coliform, suspended solids, BOD	sedimentation
West Side Division		Not Operating			
Union Bag-Camp Paper Company					
River Raisin Paper Company Division	4.57	liner board	315 tons/day	suspended solids, BOD	sedimentation
Monroe Paper Products Company	2.2	liner board	88 tons/day	coliform, suspended solids, BOD	sedimentation, chemical coagulation
Monroe Auto Equipment Company	0.016	shock absorbers	-	none	none
Ford Motor Company	130	automobile accessories	-	toxic metals, CN, oil	dilution, chemical coagulation, sewage treatment plant, alkaline chlorination
TOTAL	151.3				

INDUSTRY	Flow MGD	BOD mg/l	COD mg/l	Susp. Sol. mg/l	Sett. Sol. mg/l	Chlorides mg/l	Oil mg/l	Ph
Consolidated Paper North Plant	7.533	32-535	90-770	77-670	0-180	16-35	11-36	8
Consolidated Paper South Plant	7.0	24-315	94-417	39-392	12-235	26-34	5-29	6
Ford Motor Company	128	8-40	16-76	7-48	0-29	28-89	5-14	4-
Monroe Auto Equipment	0.0157	8-10	41-43	13-23	4	41-43	3	2-
Monroe Paper Products	2.21	77-175	41-303	43-372	15-359	29-45	9	27-
Union Bag-Camp Paper Co.	4.573	285-325	403-568	108-203	11-115	17-33	17-24	130-

(1) Weighted Geometric Mean Coliform Concentration MF/100ml.
(2) Sewage Treatment Plant outfall only.

INDUSTRY	BOD lbs.	BOD P.E.	Susp. Sol. lbs.	Sett. Sol. lbs.	Chlo lb
Consolidated Paper North Plant	17,204	101,000	7,823	780	0
Consolidated Paper South Plant	7,000	42,000	10,600	5,300	0
Ford Motor Company	48	287	8	3	16,0
Monroe Auto Equipment	NO WASTE CONSTITUENTS OF SIGNIFIC				
Monroe Paper Products	1,900	11,400	1,475	1,400	12
Union Bag-Camp Paper Co.	11,770	70,000	3,587	320	0
Total Raisin River(1)	37,900	225,000	23,500	7,800	16,0

(1) Rounded to three significant figures.

770-026 O-65 (Face p. 290)

TABLE

t. . 1	Chlorides mg/1	Oil mg/1	Phenols g/1	Iron mg/1	pH	NH_3-N mg/3	Phos-phate mg/1	ABS ug/1	Alka-linity mg/1	(1)	Cya-nides mg/1	Copper mg/1
180	16-35	11-36	8-260	0.66-1.90	6.8-7.9	0.11-0.78	0-43	120-740	110-126	38,000	0-0.03	0-0.0
235	26-34	5-29	6-36	0.85-1.96	6.5-7.7	.13-0.64	.16-1.33	180-590	16-150	1,840,000	0	<0.01-0.1
29	28-89	5-14	4-18	0.36-1.35	7.1-9.6	.13-2.61	.512-4.9	240-660	34-98	(2) 460,000	0-1.02	0.03-0.1
	41-43	3	2-8	.66-1.97	7.3-8.3	.05-.08	.668-1.28	210-260	112-154	-	0	<0.01-
359	29-45	9	27-58	.80-1.33	6.4-7.4	.24-.34	.544-.744	440-640	88-223	32,400	0	.01-0.06
115	17-33	17-24	130-180	1.24-2.79	6.8	.24-1.5	64.24	520-700	64-72	500	0	.07-0.14

TABLE

.	Susp. Sol. lbs.	Sett. Sol. lbs.	Chlorides lbs.	Oil gal.	Phenols lbs.	Iron lbs.	NH_3-N lbs.	Cyanides lbs.	Acid lbs.	Copper lbs.	Cadmium lbs.	Nickel lbs.
00	7,823	780	0	123	11.0	0	0	0	-	0	0	0
00	10,600	5,300	0	36	0.5	0	2	0	-	0	0	0
37	8	3	16,000	870	3.8	0	160	1,075	-	700	0	120
E CONSTITUENTS OF SIGNIFICANCE												
0	1,475	1,400	120	5	0.6	15	3	0	-	3	0	0
0	3,587	320	0	92	5.9	20	12	0	-	0	0	0
0 s.	23,500	7,800	16,000	1,130	21.8	35	177	1,075	-	703	0	120

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TABLE 11-VI. SUMMARY OF RANGES OF AVERAGE RESULTS OF INDUSTRIAL WASTE EFFLUENT CONCENTRATIONS

RAISIN RIVER AT MONROE

s /l	Alkalinity mg/l	(1)	Cyanides mg/l	Copper mg/l	Cadmium mg/l	Nickel mg/l	Zinc mg/l	Lead mg/l	Chromium mg/l
0-740	110-126	38,000	0-0.03	0-0.09	0-<0.01	<0.01-0.08	0-0.16	0-0.34	0-0.08
0-590	16-150	1,840,000	0	<0.01-0.70	<0.01-0.05	<0.01-0.04	0.06-1.13	0.07-0.13	<0.01-0.02
0-660	34-98	(2) 460,000	0-1.02	0.03-0.76	<0.01-0.07	<0.01-.12	<0.01-0.27	<0.01-0.04	<.01-0.24
0-260	112-154	-	0	<0.01-	<0.01	<0.01	<.01-0.03	.07-0.13	.01-0.03
0-640	88-223	32,400	0	.01-0.06	<0.01	0.01-0.02	<0.01-0.07	0.05-0.10	<.01-.01
0-700	64-72	500	0	.07-0.14	<.01-.02	<.01-0.01	1.2-4.3	0.07-0.15	.01-0.09

TABLE 12-VI. SUMMARY OF AVERAGE DAILY LOADING OF INDUSTRIAL WASTES BY EACH INDUSTRY TO RAISIN RIVER AT MONROE

ides s.	Acid lbs.	Copper lbs.	Cadmium lbs.	Nickel lbs.	Zinc lbs.	Lead lbs.	Chromium lbs.	Phosphates lbs.
	-	0	0	0	0	0	0	-
	-	0	0	0	15	0	0	9
75	-	700	0	120	125	0	136	1,046
	-	3	0	0	93	0	0	0
	-	0	0	0	0	0	0	0
75	-	703	0	120	233	0	136	1,060

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TABLE 14-VI. INDUSTRIAL EFFLUENTS CONTAINING EXCESSIVE CONCENTRATIONS OF WASTE MATERIALS

Industry	BOD (mg/l)	Cyanides (mg/l)	Suspended Solids (mg/l)	Coliform Bacteria MF/100 ml
Raisin River				
Consolidated Paper Company				
North Side				
West Clarifier	310		163	29,000
East Clarifier	327		190	46,000
Bypass			277	62,000
South Side	120		189	2,000,000
Ford Motor Company				
Sewage Treatment Plant				460,000
Main Plant		1.02		
Monroe Paper Products Company	126		99	60,800
Union Bag-Camp Paper Company	305		93	

Stormwater Overflow

All along the Lake Erie shorefront are pumping stations designed to receive surface drainage and automatically discharge it, untreated, into Lake Erie during or following rainfall and heavy surface runoff. Sampling of the discharge of these stations revealed that sewage from direct discharge or from improperly operating septic tank installations reaches the stations along with surface storm runoff.

The City of Monroe has separated its sewers, but a portion of the sanitary sewers still receives roof runoff from residences and commercial establishments. This places a burden on the sewage treatment plant and any waste load above 10 MGD is bypassed to the Raisin River, receiving chlorination only. In addition, a flood relief pumping station on the Raisin River interceptor functions when unusually high rainfall or flood stage of the river inundates the sanitary sewer to the plant. Both of these operations contribute untreated wastes to the River.

Coliform data from the mouth of the Raisin River were evaluated with respect to rainfall in the Monroe area. In the lower part of the River steady industrial and municipal waste contributions overshadowed any noticeable effect of rain on bacterial water quality. The effect of rainfall on the River above known sources of pollution, however, was strongly adverse, as in late August, 1963, when heavy rains caused the flood pumping station to operate for one hour, and coliform densities jumped to 10 and 20 times the normal levels. In times of moderate rainfall slight rises in coliform densities were noticed in the upper Raisin River, for relatively short periods of time.

Shorefront Homes

Estimates of the number of unsewered shorefront homes that discharge sewage directly, or from improperly functioning septic tanks, to Lake Erie or its tributaries were made in the 1962 conference transcript. Consultation with personnel of the Monroe County Health Department revealed several tributaries, including Plum Creek and Sandy Creek, which receive such wastes directly and via county surface drains. Much of the Lake Erie shoreline from Maple Beach to below the Raisin River, outside of the sewered area of the City of Monroe, is so affected. Surface drainage polluted with sewage reaches the Raisin River above the City of Monroe through county drains which permit discharge into the river during wet and, in some reported cases, dry conditions.

Individual reports will be made on the effects of this type of pollution in the Maple-Milleville Beach and Sterling State Park Beach areas (see Special Studies). In general it can be stated that these sources of wastes adversely affect water quality at Lake Erie bathing beaches, especially in times of rainfall and specific wind conditions favoring retention of the polluted wake along the shorefront.

Pollution from Boats

Commercial and pleasure boats make heavy use of the Michigan waters of Lake Erie. All such craft represent potential sources of pollution from oil and human wastes. The files of this Project contain reports of oil spills which appeared to originate in the middle of the Lake waters under study, undoubtedly from boats.

Enrico Fermi Atomic Reactor

The Enrico Fermi Atomic Reactor, designed to generate electric energy for domestic and industrial use, is not now in active operation but is expected to produce power sometime in 1965. Both radioactive and domestic wastes are adequately treated, and create no interference with water use.

Domestic wastes from the 150 employees of this installation are treated by a secondary treatment plant. Over 90 percent of the BOD is removed by this plant, which now operates under its design capacity of 75,000 gallons per day. Operating records are sent to the Michigan Department of Health for review.

The only radioactive wastes originating in the plant are from biweekly steam cleaning of the reactor sub-assembly, and over 99 percent consists of sodium 24 with a half-life of 15 hours. Treatment is provided by storage for 9 days in a surge tank. The effluent is then bled off at a rate determined by the radioactivity remaining in the tank and discharged to Lake Erie through a dilution canal off a lagoon in Swan Creek. Automatic monitoring devices operate continually and prevent discharge of highly concentrated radiactive material to the receiving waters. In the event radioactivity is too high after 9 days storage for discharge into the receiving waters, additional storage equal to three months capacity is available.

Tributaries to Lake Erie

Tributaries to Lake Erie are large sources of its pollution. The major source, the Detroit River, has been described in detail in Section V of this report; U. S. waters of the Detroit contribute over 95% of the pollution of the Michigan waters of Lake Erie. Other tributaries considered in this study include the Raisin River, Huron River, Swan Creek, Stony Creek, Sandy Creek, Plum Creek, and LaPlaisance Creek. Table 15-VI summarizes average quantitative loadings for each of these tributaries for total coliform organisms. Table 16-VI summarizes average values and loadings for the Detroit, Huron, and Raisin Rivers, the largest tributaries, for phosphates, nitrogen compounds, phenols, chlorides, suspended solids, cyanides, and iron. Three intensive surveys done of the Raisin River are discussed under "Special Studies".

The Huron River is a contributor of wastes high in coliform densities, phosphates, and nitrogen compounds. However, the Project was unable to demonstrate specific adverse effects on the Michigan waters of Lake Erie directly attributable to the Huron. The Huron River discharges into a large marsh at Pointe Mouillee which is subject to backwater from the already polluted waters of the Detroit River. Retention in the Pointe Mouillee marsh prevents the identification of Huron's share of nutrient and coliform loadings. Any change in water quality in Lake Erie due to the Huron is masked by other sources of pollution. After sources of pollution in the Detroit River have been eliminated or substantially controlled, the real contribution of the Huron River may be ascertained.

TABLE 15-VI. AVERAGE COLIFORM LOADINGS
TRIBUTARIES TO MICHIGAN LAKE ERIE

Tributary	Average Coliform Loading BPE*
Detroit River**	77,000
Huron River	317
Swan Creek	10
Stony Creek	51
Sandy Creek	47
Raisin River	4,500
Plum Creek	47

* One BPE = 200 billion coliform organisms

** United States waters

TABLE 16-VI. AVERAGE STREAM LOADINGS
TRIBUTARIES TO MICHIGAN LAKE ERIE

	Detroit River		Huron River		Raisin River	
	Concentration*	Loading*	Concentration*	Loading*	Concentration*	Loading*
Chlorides	23	10,100,000	36	89,200	28.6	141,000
Phosphate	0.53	218,000	1.71	4,240	.36	1,770
Nitrates	0.27	109,000	0.28	694	.13	640
Ammonia	0.33	133,000	0.26	645	.39	1,920
Organic Nitrogen	0.18	72,600	0.13	322	.27	1,330
Suspended Solids	21	8,600,000	4	9,920	9.7	47,800
Settleable Solids	18	7,200,000	-	-	2.9	14,300
Phenols	4.9	2,100	3.1	8	7.1	35
Iron	0.62	260,000	.09	223	0.78	3,840

* Concentration in mg/l, except phenols, which are in ug/l. Detroit River average concentrations are adjusted to flow for the entire United States section at the mouth.

* Loadings in pounds per day.

SPECIAL STUDIES

Several special studies were made in areas where pollution problems were not clearly defined by routine investigation of water quality and waste sources. Included in these activities were three intensive surveys of the Raisin River, a pollution study of the Maple-Milleville Beach area, collection and analysis of bottom deposits in the Lake, determination of distribution of currents in Michigan Lake Erie, a study of rooted aquatic plants, and a special pollution investigation of the Sterling State Park bathing beaches.

Raisin River Intensive Surveys

Three intensive surveys of the Raisin River were conducted by Project personnel during winter and summer months. Figure 13-VI shows the sampling stations on a map of the Raisin River, and Tables 17-VI through 19-VI summarize the results. Major waste sources are introduced to the river between station T83 and T84 (Monroe Sewage Treatment Plant and Consolidated Paper Company, South Plant) and between stations T82 and T83 (Consolidated Paper Company, North Plant, Union-Bag Company and Ford Motor Company). Wastes from the Monroe Paper Products enter the river between T88 and T89.

From the upstream stations to station T84 (above most waste sources) coliform densities in the river averaged under 20,000 organisms per 100 ml during all surveys and under 5,000 organisms per 100 ml during two. Below station T84 average values were over 100,000 organisms per 100 ml during all surveys. The backwater effect of the Lake and increased volume of low bacterial industrial waste from the Ford Motor Company reduced coliform densities at the mouth to values of 1,350 organisms per 100 ml during winter months and to 30,000 and 120,000 organisms per 100 ml during summer months.

In June 1963 the effluent of the Monroe Sewage Treatment Plant was monitored and had a geometric mean of only 105 coliform organisms per 100 ml during the survey. Nevertheless, an increase between station T84 and T83 of 7,800 to 57,000 organisms per 100 ml was observed. This testifies to the extreme influence of the effluents from the paper mills along the Raisin River upon its coliform density and bacterial water quality.

High concentrations of suspended and settleable solids were noted in the effluents of all paper mills, but not in that of the Ford Motor Company or Monroe Sewage Treatment Plant. Cyanides from one Ford effluent were excessive, at 1.3 mg/l. Iron concentrations in all effluents were low but the average value at the mouth was high, at 0.78 mg/l. Analysis of toxic metals during survey number two indicated substantial quantities of copper, nickel and zinc. Shown below is a summary of amounts of wastes discharged into the Raisin River between station T89 and the mouth, compared to the increase in stream loadings between those two points.

Constituent	Waste Sources pounds/day	Increase in Loadings pounds/day
Phenols	24	15
Chlorides	19,600	60,000
Cyanides	1,050	135
BOD	49,000	35,600
Iron	40	1,300
Suspended Solids	23,300	20,600

The two-mile stretch of the Raisin River immediately above its mouth receives large quantities of industrial and domestic wastes, and is not only grossly polluted, but also seriously degrades an area of Lake Erie near its mouth. Waste constituents discharged to the River are high in coliform, suspended solids, and cyanide concentrations, and include large quantities of oxygen-consuming substances, as evidenced by the discharge of 49,000 pounds per day of BOD (equivalent in oxygen-consuming capacity to the untreated wastes of a population of about 225,000). The lower Raisin River is frequently completely devoid of dissolved oxygen, resulting in a continuous state of putrefaction during the summer months. All uses of the Raisin River except waste disposal and navigation have been eliminated by pollution, and deposits of settleable solids at the mouth interfere with these uses to the extent that annual dredging is required to remove bottom material and keep the channels open for ship movement. Bacterial counts in the lower River are excessively high and represent prohibition of any possible recreational use of the water. The effect of the Raisin River upon Lake Erie is seen in the enrichment of the waters of the western basin and in high coliform levels at bathing beaches near its mouth (including Sterling State Park).

770-026 O-65-20

TABLE 17-VI. SUMMARY OF RESULTS
RAISIN RIVER SURVEY NUMBER 1
NOVEMBER 16 THROUGH DECEMBER 12, 1962

Station	Average Flow (cfs)	Geometric Mean Coliform Densities org./100 ml	Average Phenol µg/l	Average Chloride mg/l	Average Iron mg/l	Average Suspended Solids mg/l	Average Cyanides mg/l
T80 (mouth)	330	1,350	5.8	24.7	.78	5	.07
T81	330	3,030	6.0	24.6	.80	9	.24
T82	160	33,900	6.4	23.8	.46	36	.46
T83	148	101,000	9.6	23.9	.28	10	0
T84	135	3,100	3.8	23.2	.18	5	0
T85	134	4,100	7.0	23.0	.15	5	-
T86	132	4,000	4.6	23.2	.07	5	-
T87	132	3,700	2.6	22.2	.18	6	-
T88	132	3,140	8.6	22.7	.09	4	-
T89	132	547	3.5	21.8	.10	2	-
T90	132	295	4.8	21.5	.17	13	0

	COD mg/l	Phenol µg/l	Chloride mg/l	Iron mg/l	Average Suspended Solids mg/l	Cyanides mg/l
Consolidated Paper Company - North Plant	267	0	32	0.16	99	-
Consolidated Paper Company - South Plant	13-310	0-13	23-90	0.09-0.72	17-234	-
Mason Run (Consolidated North and Union-Bag Camp Company)	504	49	23	1.22	298	-
Ford Motor Company	22-35	0	23-27	0.10-0.25	3-8	1.3

TABLE 18-VI. SUMMARY OF RESULTS
RAISIN RIVER SURVEY NUMBER 2
JUNE 9 THROUGH JUNE 12, 1963

Station	Average Flow (cfs)	Geometric Mean Coliform Densities org./100 ml	Average Phenols µg/l	Average Chlorides mg/l	Average Suspended Solids mg/l
T80 (mouth)	868	120,000	8.6	32.6	8
T81	868	150,000	5.0	26.8	12
T82	704	170,000	23.8	45.2	59
T83	682	57,000	3.6	29.2	37
T84	668	7,800	4.4	41.8	54

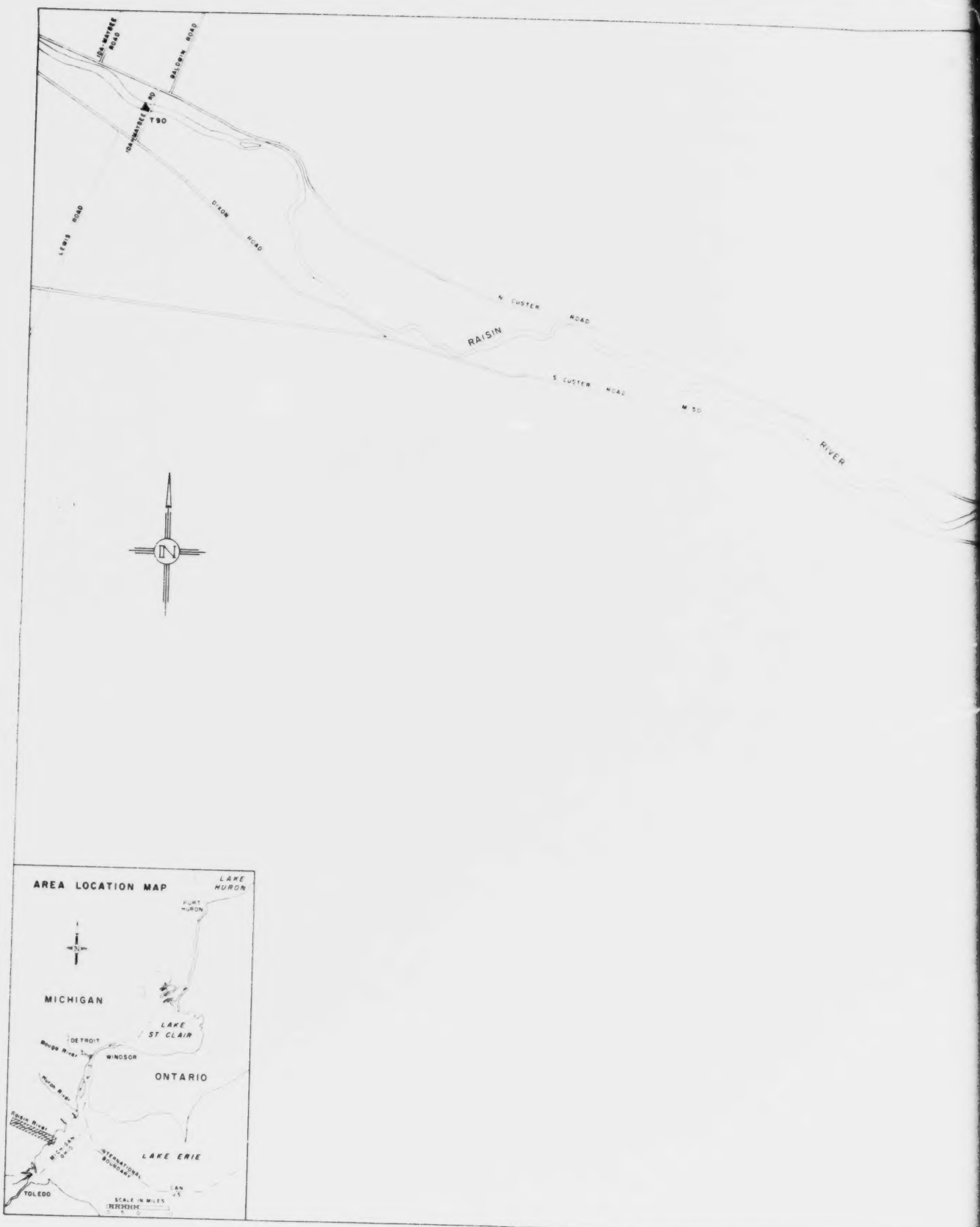
Station	Average Flow (cfs)	Average Cyanides mg/l	Average BOD mg/l	Average Copper mg/l	Average Nickel mg/l
T80 (mouth)	868	.03	7.6	.16	.02
T81	868	.30	14.4	.22	.01
T82	704	0	24.8	.06	.03
T83	682	<.01	10.0	.02	.02
T84	668	.01	8.4	.03	.03

Station	Average Flow (cfs)	Average Zinc mg/l	Average Lead mg/l	Average Chromium mg/l	Average Cadmium mg/l
T80 (mouth)	868	.02	<.01	.01	-
T81	868	.04	.01	.02	-
T82	704	.10	.04	<.01	<.01
T83	682	.06	.01	<.01	<.01
T84	668	.01	<.01	<.01	<.01

TABLE 19-VI. SUMMARY OF RESULTS
RAISIN RIVER SURVEY NUMBER 3
AUGUST 26 THROUGH AUGUST 29, 1963

Station	Average Flow (cfs)	Geometric Mean Coliform Densities org./100 ml	Average Phenols µg/l	Average Suspended Solids mg/l
T80	245	30,000	6.8	16
T82	72	200,000	26.0	30
T83	60	420,000	19.8	55
T84	46	430,000	12.0	31
T86	45	17,000	99.8	9
T88	45	16,000	15.0	8
T89	45	720	2.5	3

	Coliform Densities org./100 ml	Suspended Solids mg/l	Settleable Solids mg/l
Mason Run (Consolidated North and Union-Bag Camp Company)	26,000-50,000	108-203	11-115
Consolidated Paper Company - North Plant	6,200-190,000	192-670	0-180
Consolidated Paper Company - South Plant	100-5,000,000	21-637	0-567
Monroe Paper Products	2,000-80,000	43-372	15-359
Monroe Sewage Treatment Plant	20,000-420,000	23-31	0-2

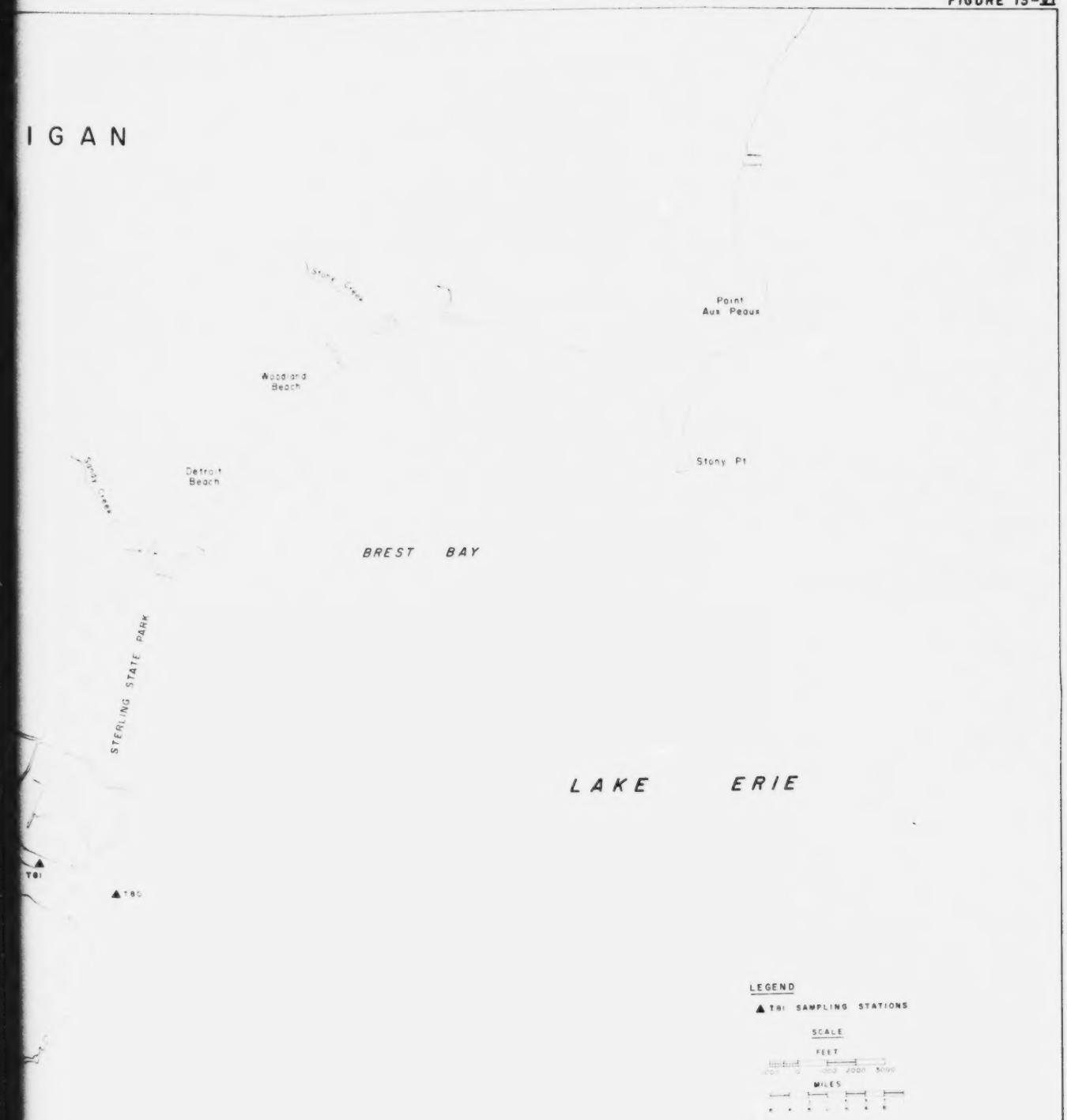

IDA-MAYBEE ROAD
BALDWIN ROAD
IDA-MAYBEE RD
T90
LEWIS ROAD
DIXON ROAD
N. CUSTER ROAD
RAISIN
S. CUSTER ROAD
M 50
RIVER
N
AREA LOCATION MAP
LAKE HURON
PORT HURON
MICHIGAN
LAKE ST CLAIR
DETROIT
Rouge River
WINDSOR
ONTARIO
Huron River
Raisin River
MICHIGAN
OHIO
INTERNATIONAL BOUNDARY
LAKE ERIE
CAN
US
TOLEDO
SCALE IN MILES

301 a

MICHIGAN

301 L

FIGURE 13-VI



DETROIT RIVER-LAKE ERIE PROJECT

LOCATION OF SAMPLING STATIONS

RAISIN RIVER

U.S. DEPARTMENT OF HEALTH, EDUCATION, AND WELFARE
PUBLIC HEALTH SERVICE
REGION V GROSSE ILE, MICHIGAN

3 of C

Bottom Deposits

From the mouth of the Detroit River to Pointe Mouillee, extending as far eastward as the Detroit River Light, the bottom is in poor condition. From Pointe Mouillee to Stony Point, in the center of Swan Creek Bay and in the deep water east of Stony Point, the bottom is in fair to poor condition. From Stony Point to the Raisin River, there are poor areas of bottom condition in the center of Brest Bay and in the deeper water directly east of the mouth of the Raisin River. The condition of the bottom is very poor at the mouth of the Raisin River. Below the Raisin River south to Otter Creek the bottom is in fair condition near the shore and poor offshore. From Otter Creek to the south end of the Michigan waters the bottom is fair to good condition.

Along the United States shore near the mouth of the Detroit River there is a large area whose bottom condition is poor. This area, extending from the Trenton Channel past Pointe Mouillee as far east of the Detroit River Light and southerly to the center of Swan Creek, indicates the contribution of the effluent of the Trenton Channel.

Figure 14-VI shows bottom conditions as contours. Tables 20-VI through 25-VI summarize bottom deposits in the Raisin River and various segments of Michigan Lake Erie. In addition to the results shown in these tables, analysis of the bottom deposit supernatant was made for phenol, phosphate, nitrate, and ammonia concentrations, and all these factors, including field observations, were considered in evaluating bottom conditions.

TABLE 20-VI. SUMMARY OF BOTTOM MATERIALS - MICHIGAN LAKE ERIE
MOUTH OF DETROIT RIVER TO POINTE MOUILLEE

	Number of Samples	Maximum	Minimum	Mean	Remarks
pH					
Inshore	12	7.6	7.2	7.4	Small area of 7.2 near navigation channel.
Offshore	13	9.2	6.6	7.5	
% IRON					
Inshore	10	9.98	<.01	3.86	High (9%) Pointe Mouillee area.
Offshore	9	6.11	.28	2.77	
% OIL AND GREASE					
Inshore	12	1.12	.03	.65	Very high near Detroit River Light off Pointe Mouillee.
Offshore	12	1.05	.01	.45	
% TOTAL VOLATILE SOLIDS					
Inshore	12	10.7	1.1	6.07	Fair condition.
Offshore	13	8.1	2.0	5.29	

CONCLUSION: Bottom is in poor condition on the American side extending as far eastward as the Detroit River Light. River is widening and losing velocity throughout this area allowing solids to settle out.

TABLE 21-VI. SUMMARY OF BOTTOM MATERIALS - MICHIGAN LAKE ERIE
POINTE MOUILLEE TO STONY POINT

	Number of Samples	Maximum	Minimum	Mean	Remarks
pH					
Inshore	10	7.7	7.2	7.49	
Offshore	25	7.8	7.4	7.53	
% IRON					
Inshore	10	3.20	.02	1.22	
Offshore	24	4.82	.01	2.13	
% OIL AND GREASE					
Inshore	10	.60	.01	.26	Low nearshore; higher values in center of Swan Creek Bay and east of Stony Point.
Offshore	24	.99	.02	.38	
% TOTAL VOLATILE SOLIDS					
Inshore	10	12.0	5.8	8.8	Fair as far south as Stony Point and poor (10%) east of Stony Point.
Offshore	25	13.2	2.0	7.3	

CONCLUSIONS: Bottom is in fair to poor condition with poor areas in center of Swan Creek Bay, and in deep water east of Stony Point. Both areas favor the settling of solids because of reduction in current velocity

TABLE 22-VI. SUMMARY OF BOTTOM MATERIALS - MICHIGAN LAKE ERIE
STONY POINT TO RAISIN RIVER

	Number of Samples	Maximum	Minimum	Mean	Remarks
pH					6.7 center Brest Bay.
Inshore	7	7.8	7.2	7.41	
Offshore	27	7.6	6.9	7.3	
% IRON					High west of Stony
Inshore	8	6.30	.002	2.48	Point and center of
Offshore	24	9.50	.02	2.84	Brest Bay.
%OIL AND GREASE					Low nearshore; high in
Inshore	8	1.2	.03	.23	center of Brest Bay.
Offshore	25	1.0	.02	.36	
% TOTAL VOLATILE SOLIDS					High in deep water south of Stony Point
Inshore	7	13.4	1.0	6.86	and in center of
Offshore	26	18.3	2.8	9.12	Brest Bay.

CONCLUSION: A poor area exists in the center of Brest Bay and in deeper water directly east of the Raisin River mouth. Shoreline areas are fair to good.

TABLE 23-VI. SUMMARY OF BOTTOM MATERIALS - MICHIGAN LAKE ERIE
RAISIN RIVER

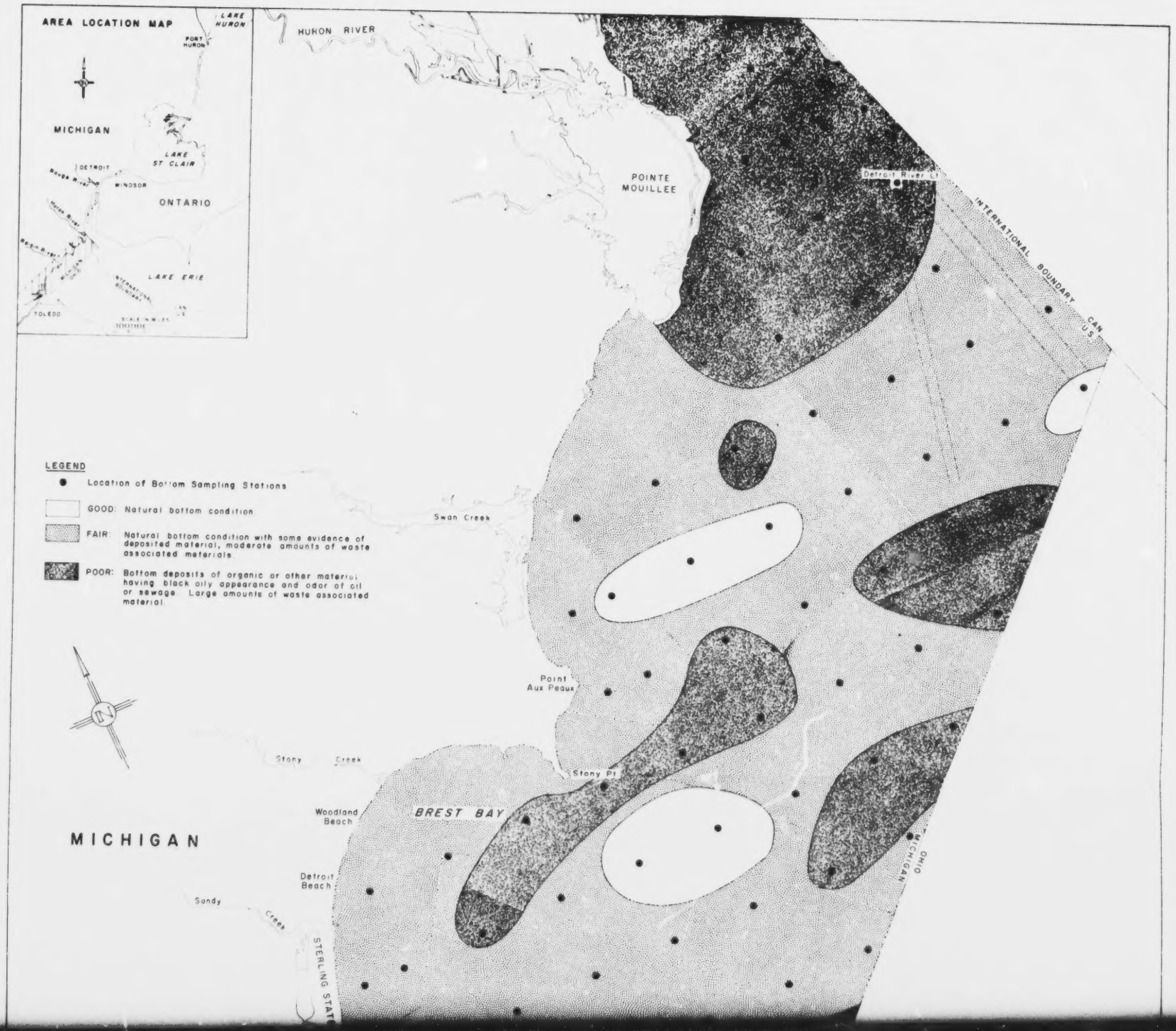
	Number of Samples	Maximum	Minimum	Mean	Remarks
% IRON	4	6.30	2.30	4.33	High 4% in Raisin and around mouth.
% OIL AND GREASE	4	2.74	2.0	1.06	High in Raisin River.

CONCLUSIONS: Condition of bottom is very poor in the Raisin River.

TABLE 24-VI. SUMMARY OF BOTTOM MATERIALS - MICHIGAN LAKE ERIE
RAISIN RIVER TO OTTER CREEK

	Number of Samples	Maximum	Minimum	Mean	Remarks
pH					
Inshore	4	8.0	7.4	7.6	7.8 to 8.0 nearshore.
Offshore	19	7.7	7.1	7.3	
% IRON					
Inshore	3	1.24	.003	.47	Low values.
Offshore	17	3.1	.006	1.22	
% OIL AND GREASE					
Inshore	4	.13	.01	.07	Low values throughout.
Offshore	19	.86	.02	.15	
% TOTAL VOLATILE SOLIDS					
Inshore	3	13.0	4.8	8.3	Poor condition
Offshore	19	18.3	1.3	6.5	

CONCLUSION: Bottom is in fair condition nearshore and poor offshore.


AREA LOCATION MAP
LAKE HURON
PORT HURON
MICHIGAN
LAKE ST. CLAIR
DETROIT
WINDSOR
ONTARIO
LAKE ERIE
TOLEDO
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POINTE MOUILLEE
Detroit River Lt
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Location of Bottom Sampling Stations
GOOD: Natural bottom condition
FAIR: Natural bottom condition with some evidence of deposited material, moderate amounts of waste associated materials.
POOR: Bottom deposits of organic or other material having black oily appearance and odor of oil or sewage. Large amounts of waste associated material.
Swan Creek
Point Aux Peaux
Stony Creek
Stony Pt
BREST BAY
Woodland Beach
MICHIGAN
Detroit Beach
Sandy Creek
STERLING STATE
OHIO
MICHIGAN

305 a

Point
Aux Peaux
Stony Creek
Stony Pt.
Woodland
Beach
BREST BAY
MICHIGAN
Detroit
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Sandy
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OHIO
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La Plaisance
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Bolles
Harbor
Otter
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Toledo
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FIGURE 14-VI

DETROIT RIVER-LAKE ERIE PROJECT

CLASSIFICATION OF BOTTOM CONDITION AS INDICATED BY BOTTOM DEPOSITS

MICHIGAN WATERS OF LAKE ERIE

U.S. DEPARTMENT OF HEALTH, EDUCATION, AND WELFARE
PUBLIC HEALTH SERVICE
REGION V GROSSE ILE, MICHIGAN

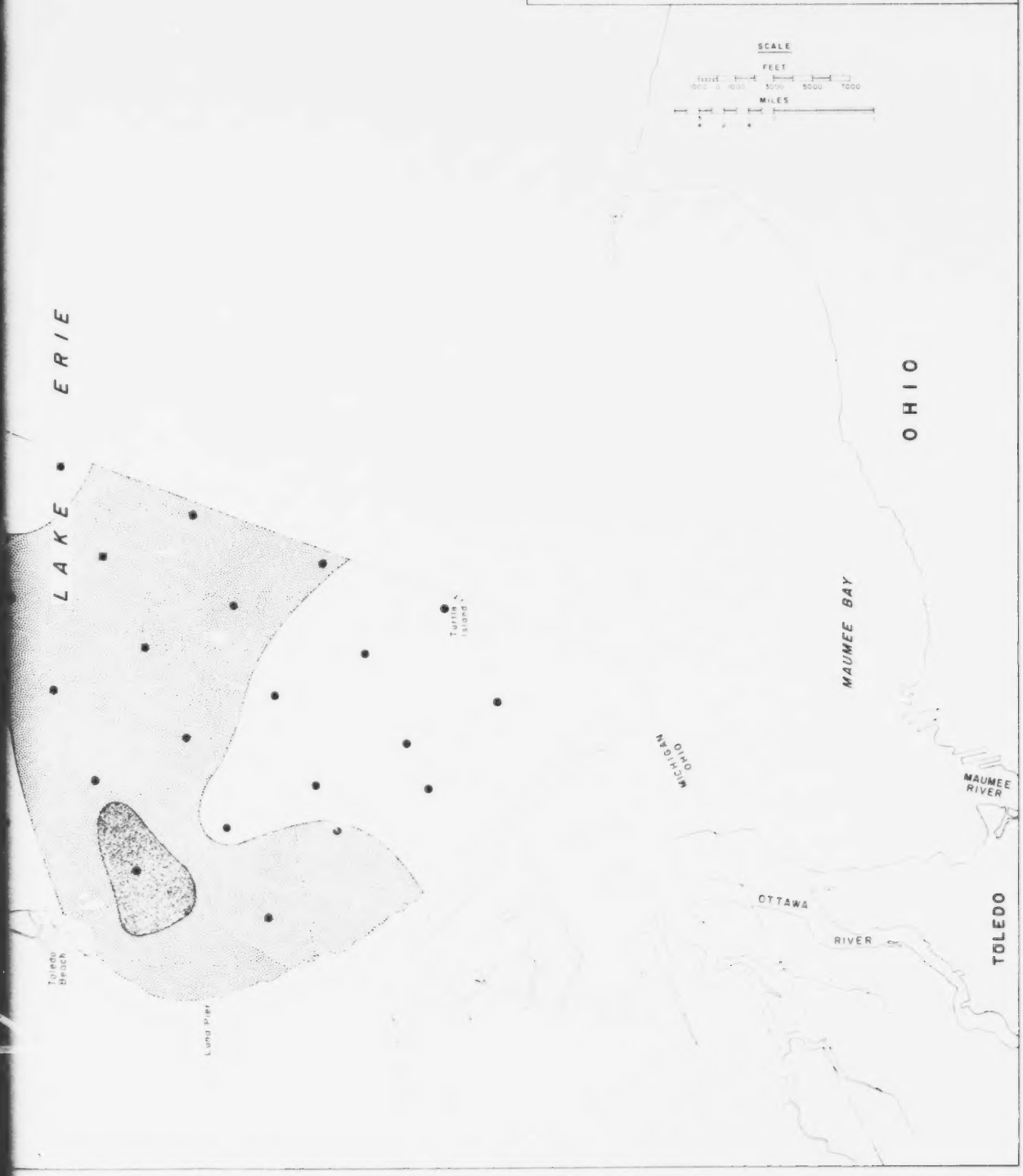

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TABLE 25-VI. SUMMARY OF BOTTOM MATERIALS - MICHIGAN LAKE ERIE
OTTER CREEK TO SOUTH END OF MICHIGAN AREA

	Number of Samples	Maximum	Minimum	Mean	Remarks
pH					7.2 to 7.4; 6.8 to 6.9 nearshore south of Otter Creek.
Inshore	8	7.8	6.9	7.3	
Offshore	19	7.4	6.8	7.2	
% IRON					Low except nearshore south of Otter Creek.
Inshore	5	4.82	.004	1.50	
Offshore	15	5.50	.008	2.28	
% OIL AND GREASE					Low values except south of Otter Creek.
Inshore	6	.56	.007	.14	
Offshore	16	.34	.02	.15	
% TOTAL VOLATILE SOLIDS					Good condition - 4 to 6%.
Inshore	8	7.2	3.3	4.94	
Offshore	17	30.0	3.1	7.56	

CONCLUSION: Bottom is good to fair except for a poor area nearshore south of Otter Creek.

Hydrologic Studies

Special hydrologic investigations were made of the Michigan waters of Lake Erie to show the relationship between sources of wastes and areas affected by pollution. Of special interest was the path of dispersion of the waters of the Detroit River into Lake Erie under varying weather conditions. Rhodamine B fluorescent dye and a fluorometer were used in conjunction with surface and sub-surface floats or drogues to assist in this determination.

Wind is the primary factor influencing water movement in the open water sections of Lake Erie. The response of surface waters to wind changes is very rapid. Few instances of a carryover effect due to differing wind conditions preceding a survey were noted.

The Detroit River outlet into the Lake is a strong factor influencing currents in the immediate area of its debouchment, diminishing rapidly beyond the Detroit River Light. Wind effects are noted as far north as Project sampling range DT 3.9, although the River current is by far the greater influencing force at this point. South of Pointe Mouillee wind forces predominate over Detroit River current.

Seiches and wind affect the shallow areas and mouths of tributaries, causing inward and outward water movement independent of the prevailing current patterns in open water sections of the Lake. These estuarine-like movements are local in effect, from a current pattern standpoint, but may be much more extensive in terms of water quality, as is the case with the Raisin River.

Vertical temperature profiles, taken regularly during dye vector work, showed nothing suggesting stratification, so that surface current pattern results were assumed to apply to the water mass as a whole. Horizontal surface temperature profiles calculated in the northern section of the study area support fluorometric and dye vector study results closely.

The prevailing wind direction on the Michigan waters of Lake Erie is southwest, occurring 24 percent of the time on a ten-month basis (March through December). Winds with a southerly component, namely those from the southeast, south, and southwest, account for 50 percent of the total. During the months of June, July and August, when recreational water uses are at a peak, southwest winds and winds with a southerly component occur 19 percent and 49 percent of the time respectively. These values are somewhat lower than the ten-month average, possibly because calm and near-calm conditions are more frequent during the summer than during the year as a whole.

Figures 15-VI through 18-VI depict current patterns in the Michigan waters of Lake Erie determined under varying wind conditions. The description of the wind direction (i.e. south wind) indicates the direction from which the wind blows; a south wind comes out of the south and blows toward the north. The large arrows denote the dispersion of Detroit River currents, while the small arrows indicate lake currents considered to be outside of the influence of the Detroit River.

A narrative description of the observed currents under each set of wind conditions follows with an estimate of the frequency of occurrence of the specific wind condition.

North (5 percent occurrence)

Water movement in the Michigan waters of Lake Erie is predominantly southerly to south-southwesterly for a north wind. Thus, Detroit River water would be transported south to Stony Point and across the Raisin River Channel if this wind condition prevailed for a sufficient length of time. Little data was obtained in Brest Bay on north winds, but from what is available, a generally southerly current pattern, paralleling the shoreline, may be assumed. It does not appear likely that Detroit River water moves west in the Bay

as far as the beaches, however. East of the Project study area, movement is to the south in the vicinity of the Detroit River Light, becoming southeasterly as distance from the River mouth increases.

Northeast (9 percent occurrence)

The predominant current direction for a northeast wind is southwesterly. As was the case with a north wind, Detroit River water could enter Brest Bay if a strong northeasterly wind persisted for a day or two. Field observations made during April and May of 1964 show that water movement near the beach at Sterling State Park is variable but generally has a southerly component for this wind condition. This variability is probably due to unsteady water levels caused by seiche action or wind set-up while field measurements were being performed.

East (7 percent occurrence)

The current pattern for an east wind is somewhat more complicated than for the two wind conditions just mentioned. Water movement in the West Outer and East Outer Channels is southwesterly near the Detroit River Light, becoming westerly near the ends of the channels as wind becomes the dominant force over the River current, which dissipates with distance from the mouth.

In the area from Point aux Peaux north to Pointe Mouillee, the water mass appears to rotate in a clockwise direction when east winds are strong. Thus currents along the beach in this area are northerly for this situation. This was substantiated by results obtained by Dr. Ayers, of the University of Michigan, in a current pattern study at the Enrico Fermi Atomic Reactor.

In Brest Bay, at Stony Point, and in the area immediately to the east of the Bay, water movement is to the west. Studies made by the Project at Sterling State Park in 1964 show that currents along the beach are quite variable for an east wind, and appear to depend on water level fluctuations in the area at the time of observation. For an east wind, water passing the beach at Sterling State Park could be moving north from the Raisin River, west from Brest Bay, or South from the Stony or Sandy Creek areas.

In that part of the Detroit River debouchment lying to the east of the Detroit River Light and the channels, an east wind appears to cause a large-scale counter-clockwise rotation of surface waters.

Southeast (15 percent occurrence)

Current patterns in the case of a southeast wind are quite similar to patterns for an east wind, except that the clockwise circulation pattern in the Swan Creek area occurs more frequently as the wind intensity required to cause rotation is lower when the wind has a southerly component.

In Brest Bay and nearby areas, water movement is predominantly northwest. Along the beach at Sterling State Park currents are most frequently northerly but may also be to the south. This again is most likely due to localized differences and changes in water level.

South (11 percent occurrence)

Overall water movement in the northern part of the study area is to the south and southeast under the influence of a south wind. To the south, where the effect of the Detroit River current is little felt, water movement is north-northeast. Upon meeting, in the area south of the East Outer and West Outer Channels, the two water masses appear to resolve into one, moving along an easterly course.

Currents alongshore in the Swan Creek area are northerly, creating an eddy in the area from shore to the West Outer Channel.

In Brest Bay, and along the beaches in the bay, water movement is to the north.

Southwest (24 percent occurrence)

For a southwest wind, currents are predominantly southeast in the northern sector and northeast in Brest Bay and the area east of the Bay.

Water movement alongshore in the Swan Creek area is northerly, turning to the southeast in the vicinity of Pointe Mouillee.

Flow along the beach at Sterling State Park is northerly for a southwest wind. Thus, water quality on the beach will likely be influenced by the Raisin River.

West (10 percent occurrence)

Water movement is easterly for a west wind of moderate to high intensity. At Sterling State Park, currents alongshore are northeasterly most of the time for this wind condition.

For a light west wind, waters in Brest Bay were found, on one occasion, to be circulating in a clockwise direction. At that time currents in the area to the east of the Bay were southerly.

Northwest (13 percent occurrence)

Current patterns are south to southwesterly for a northwest wind. Currents alongshore in the Swan Creek area are southerly. Thus, Detroit River water can move south to Stony Point, and possibly into Brest Bay.

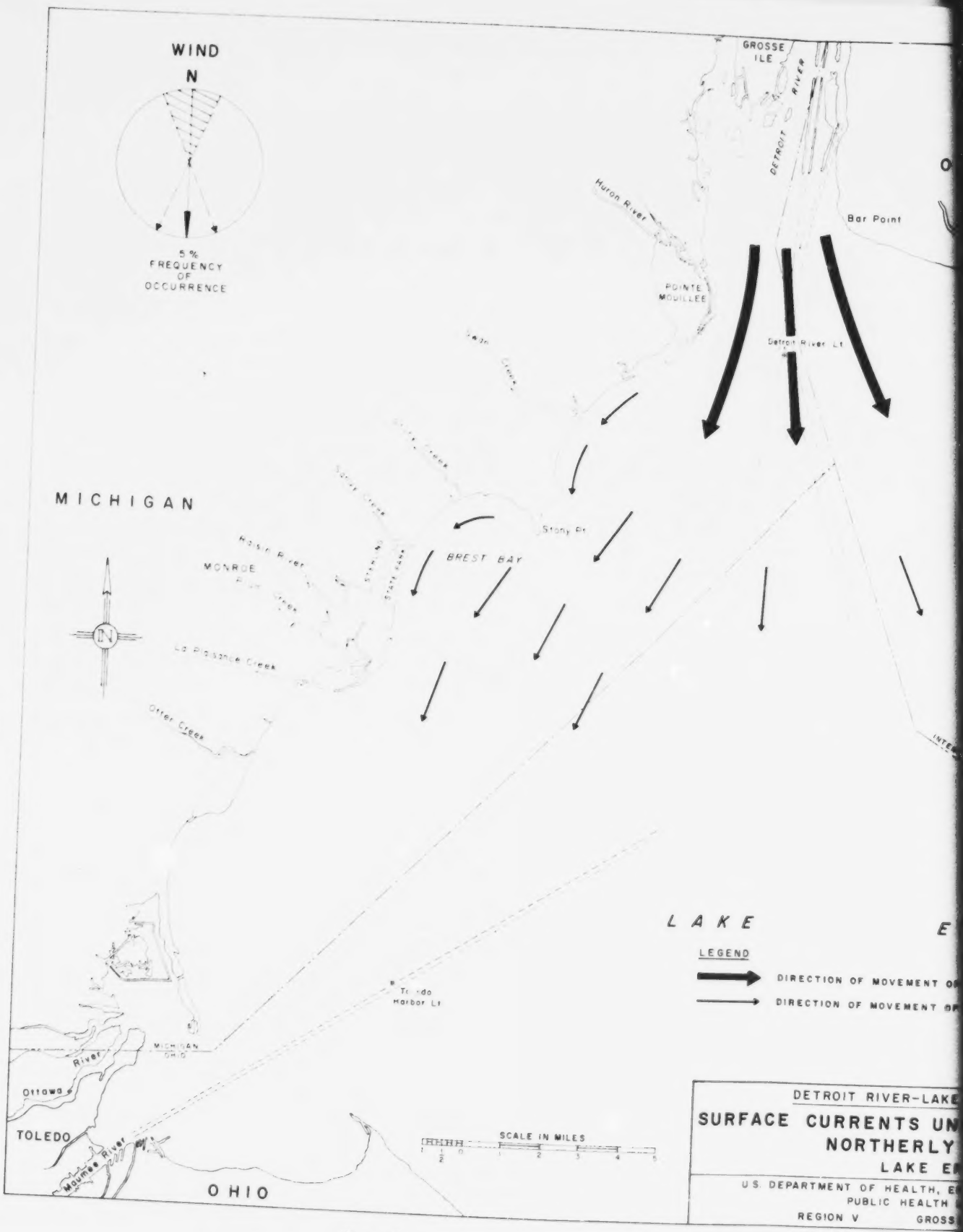
In Brest Bay, a semi-rotational, counter-clockwise water movement was observed on the one occasion that currents were studied for this wind condition. Currents at Sterling State Park beach are generally southeasterly for a northwest wind, although directional deviations can occur because of seiche action.

Summary of Findings

1. In open water sections of the Lake Erie study area, away from the mouth of the Detroit River, currents generally move with the prevailing wind.

2. At the mouth and in the debouchment, the Detroit River current is most important in determining patterns of water movement. The usual south-to-southeast-to-east path traced by water moving from the River mouth into the debouchment, and finally out into the Lake, is modified somewhat by east, southeast, and south winds. Under the influence of these winds, a counter-clockwise circulation pattern is set up in the area east of the East Outer Channel.

3. Along the beaches from Point aux Peaux north past Swan Creek, two types of current patterns occur. When winds are from the west, north, and east, which is approximately 50 percent of the time, water movement is southerly, directly from the Detroit River. For all southerly winds, flow alongshore is northerly. For a southeast wind, and possibly for a south wind also, the northerly current movement along the beaches is part of a clockwise circulation pattern extending from shore to the West Outer Channel. Thus Detroit River water can affect water quality along the beaches in the vicinity of Swan Creek 75 to 85 percent of the time.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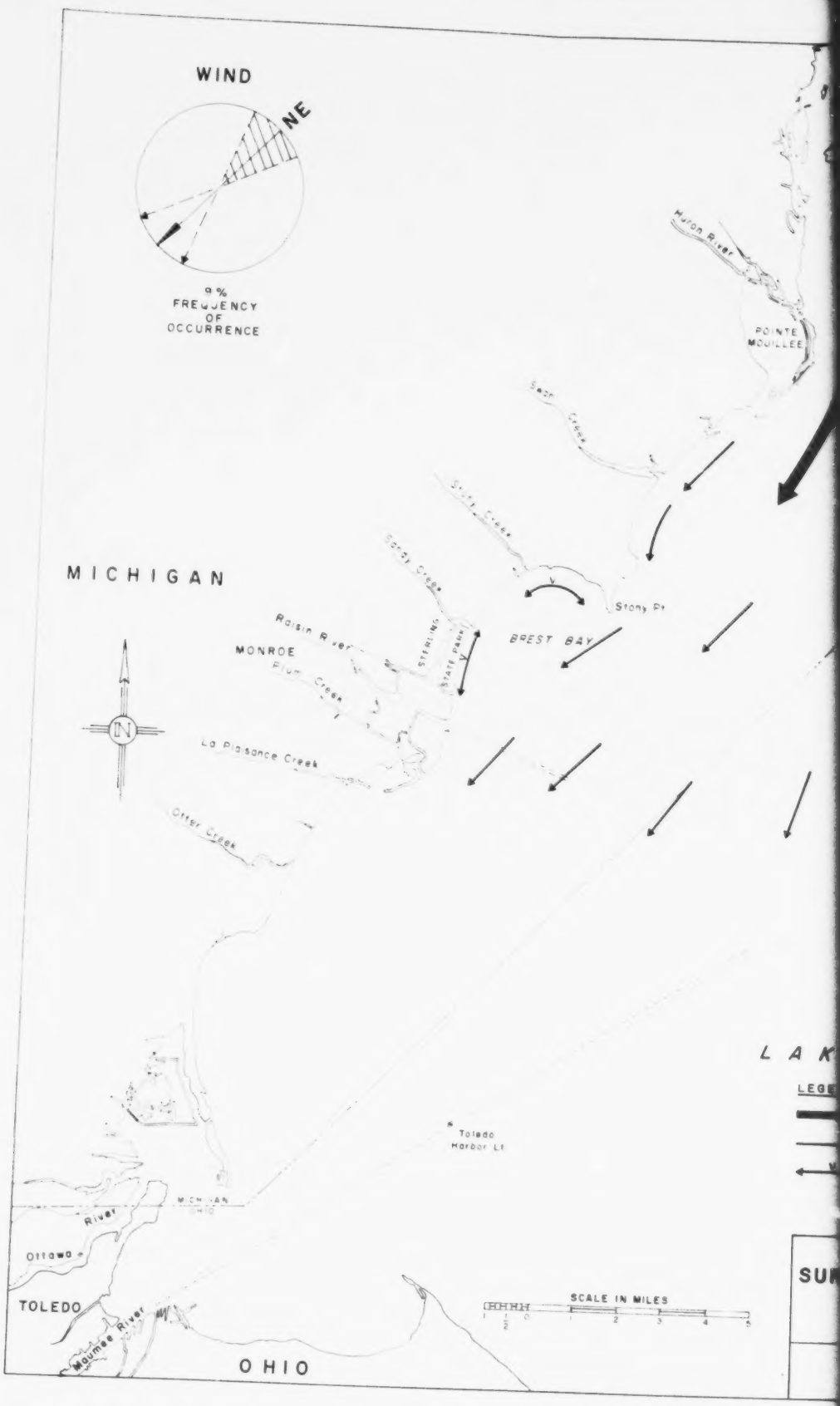

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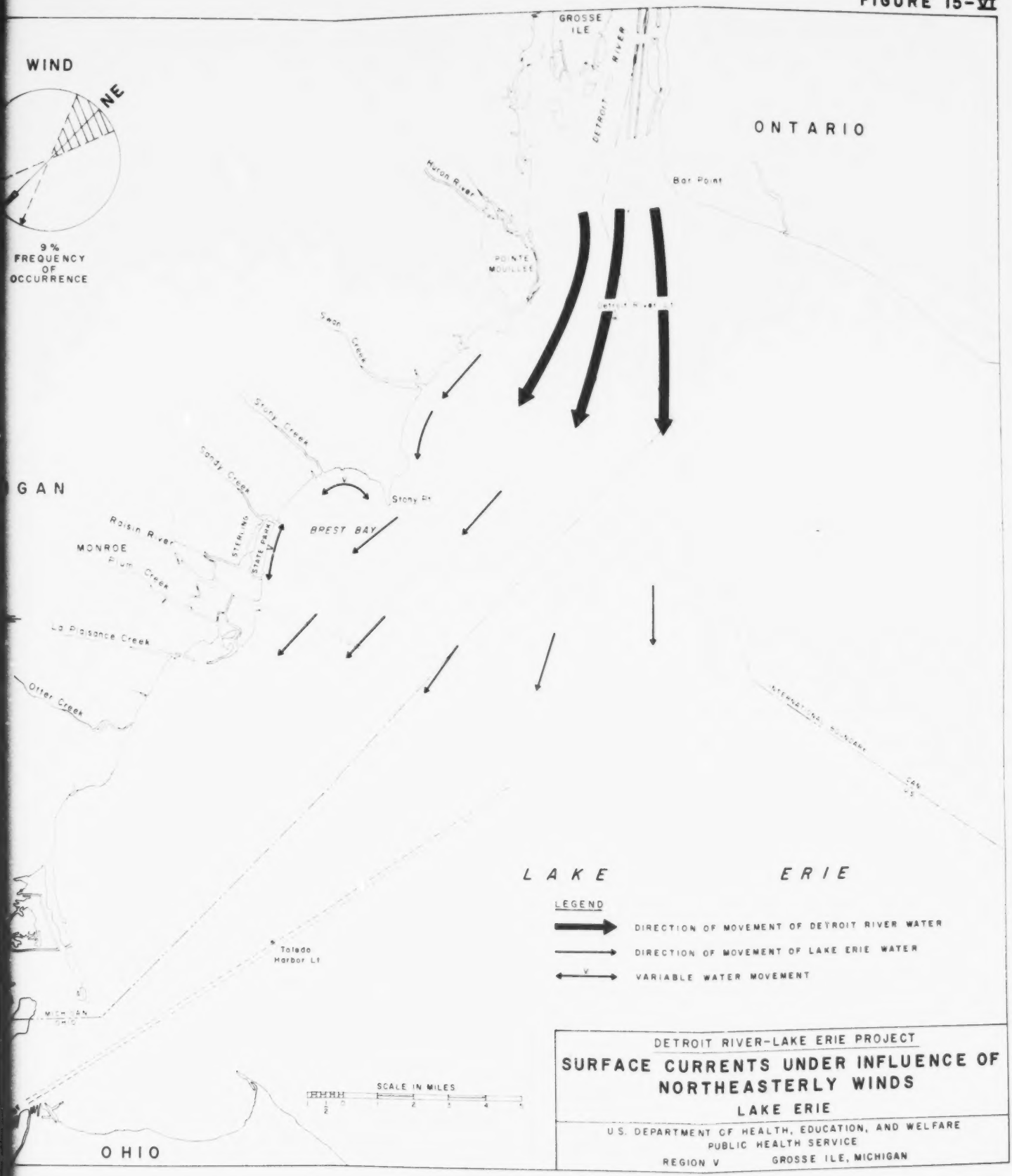
FIGURE 15-VI



DETROIT RIVER-LAKE ERIE PROJECT

SURFACE CURRENTS UNDER INFLUENCE OF NORTHEASTERLY WINDS

LAKE ERIE

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REGION V GROSSE ILE, MICHIGAN

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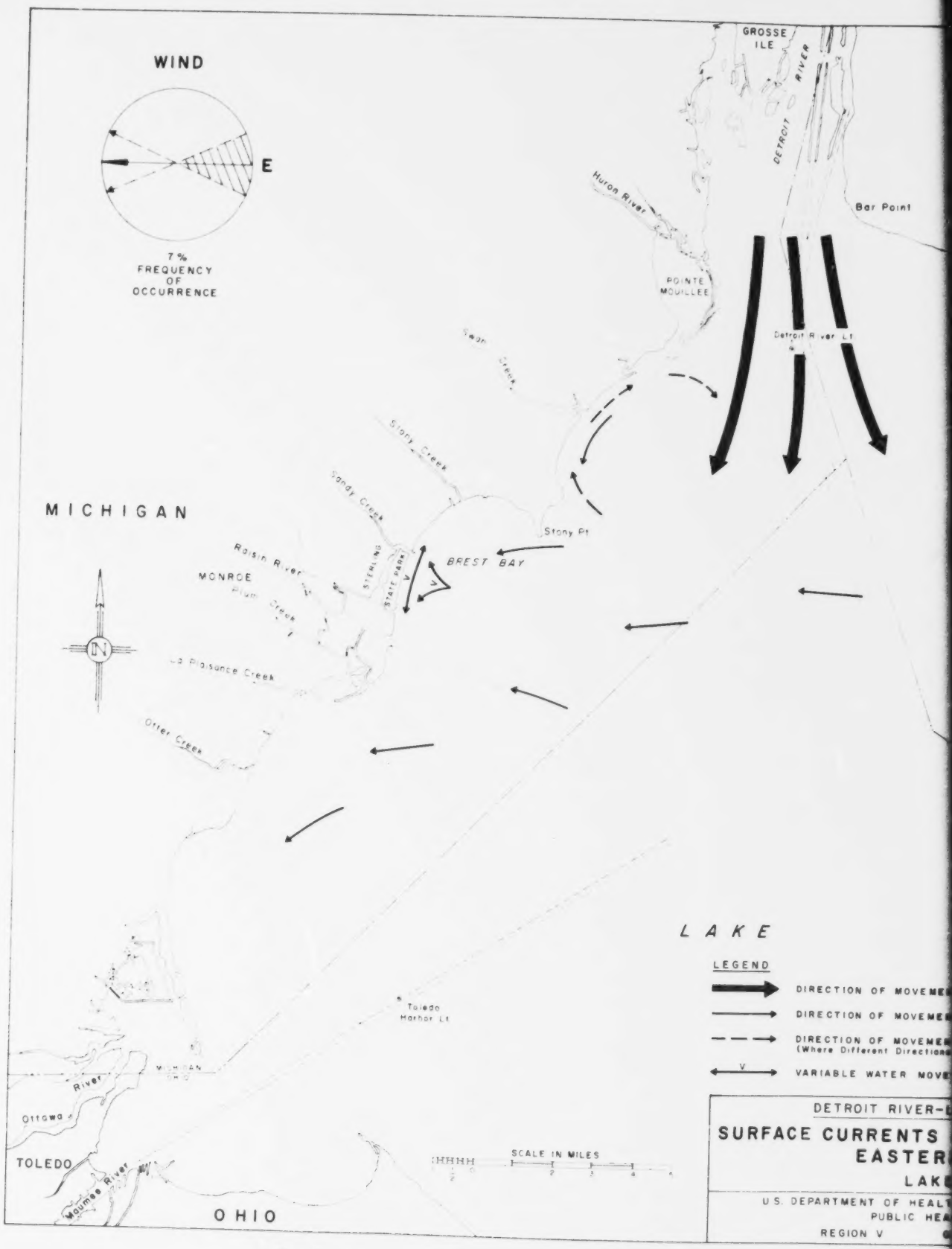
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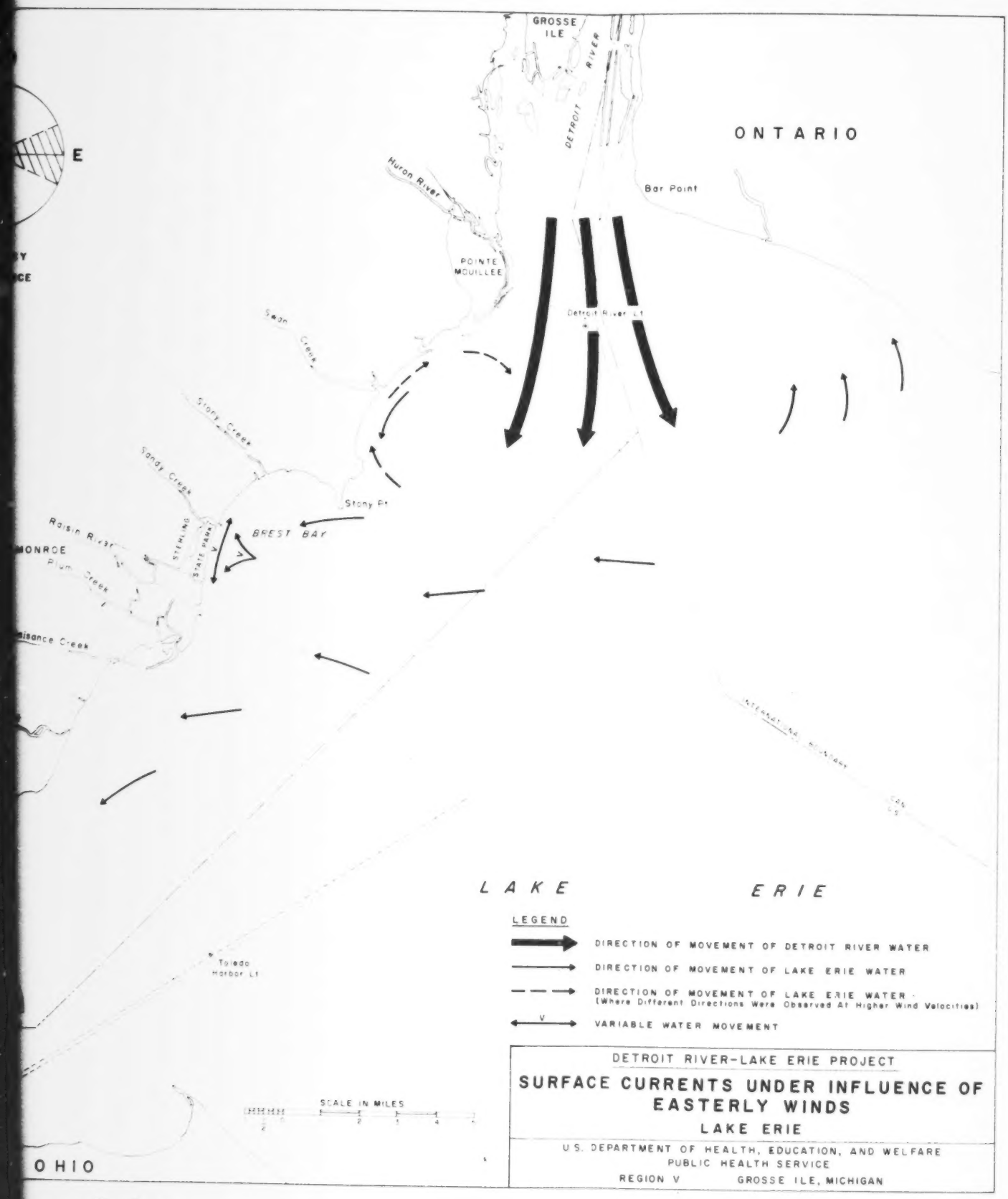

DETROIT RIVER-LAKE ERIE PROJECT

SURFACE CURRENTS UNDER INFLUENCE OF EASTERLY WINDS

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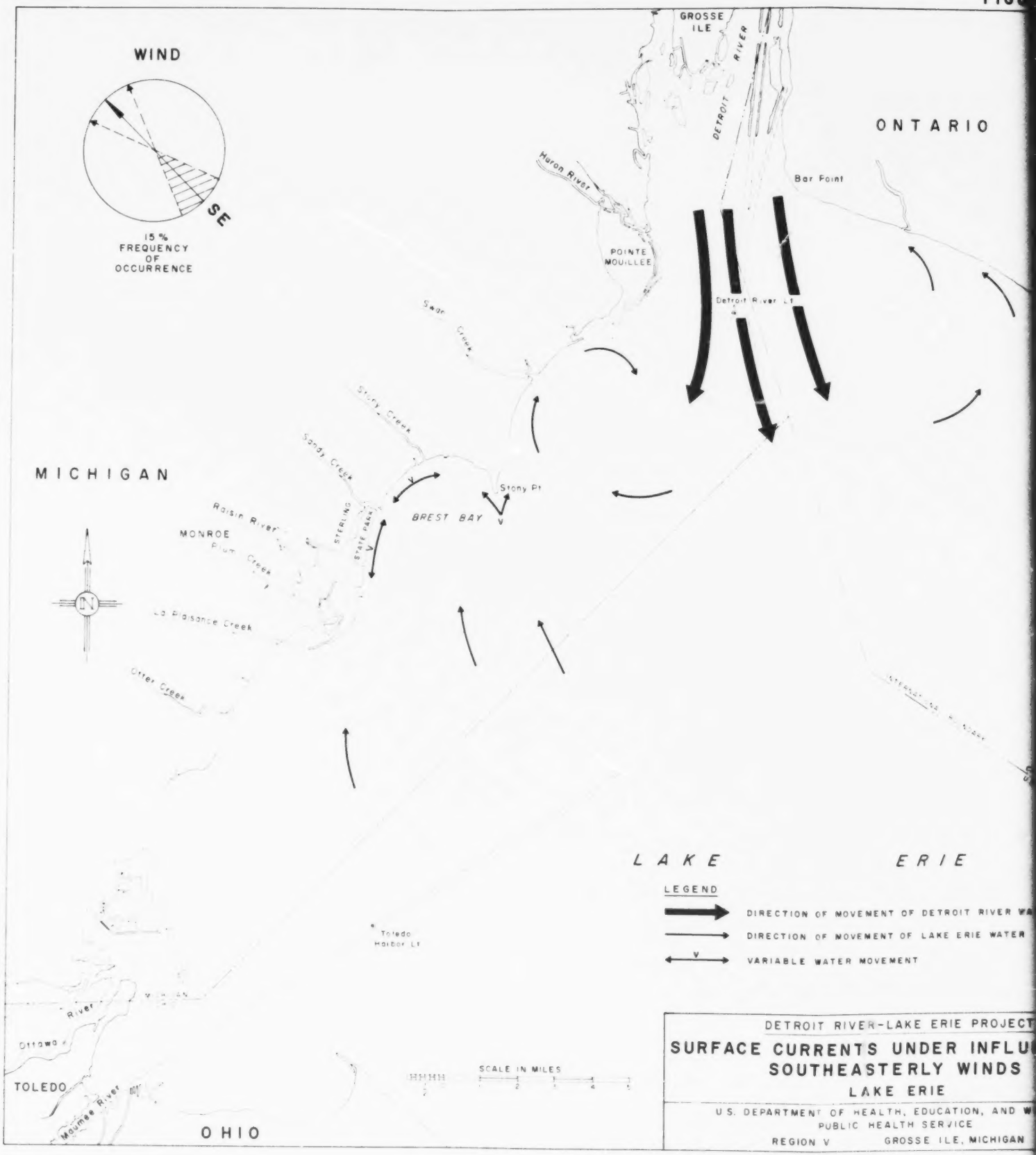

DETROIT RIVER-LAKE ERIE PROJECT

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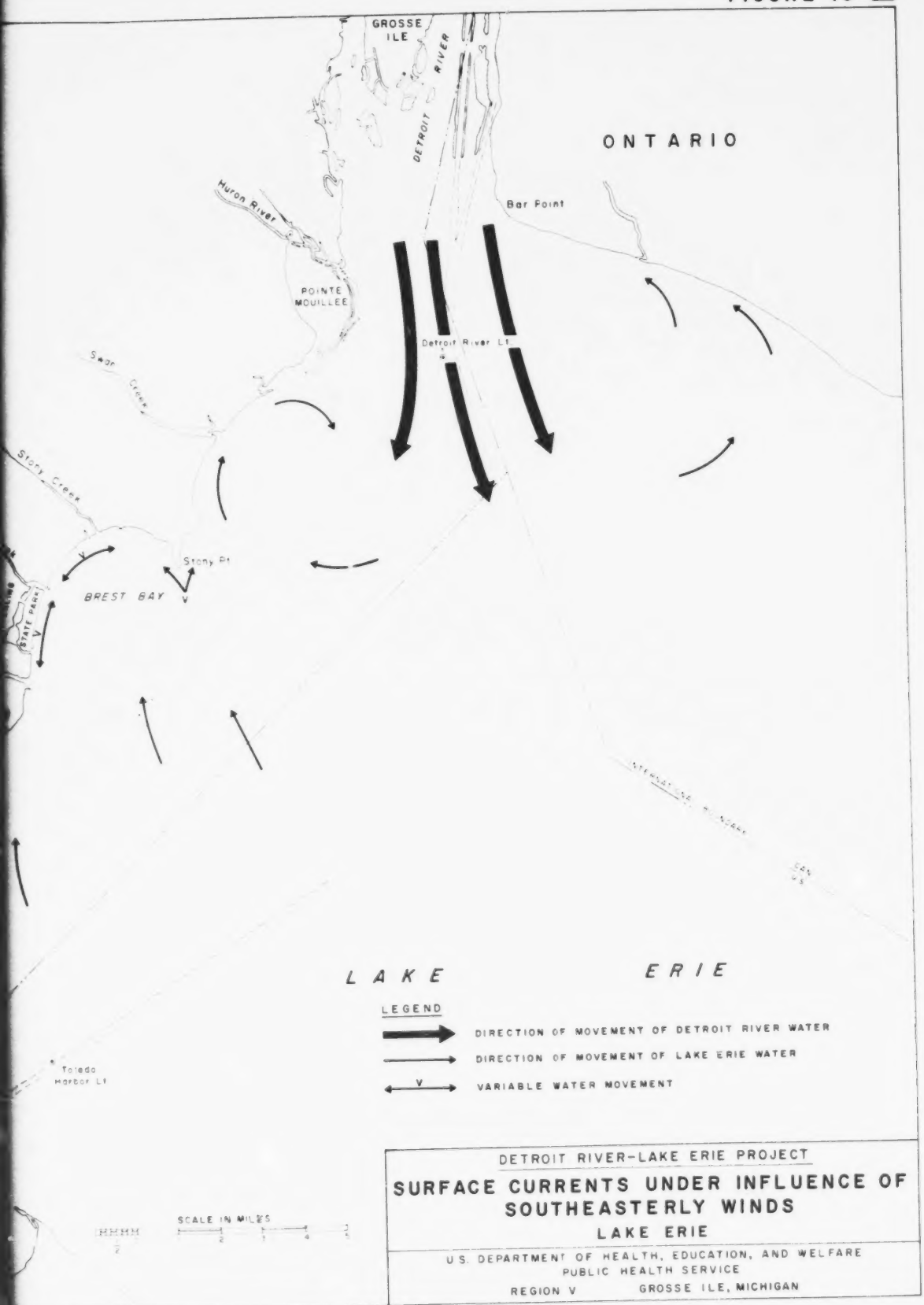
FIGURE 16-VI



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SURFACE CURRENTS UNDER INFLUENCE OF SOUTHEASTERLY WINDS

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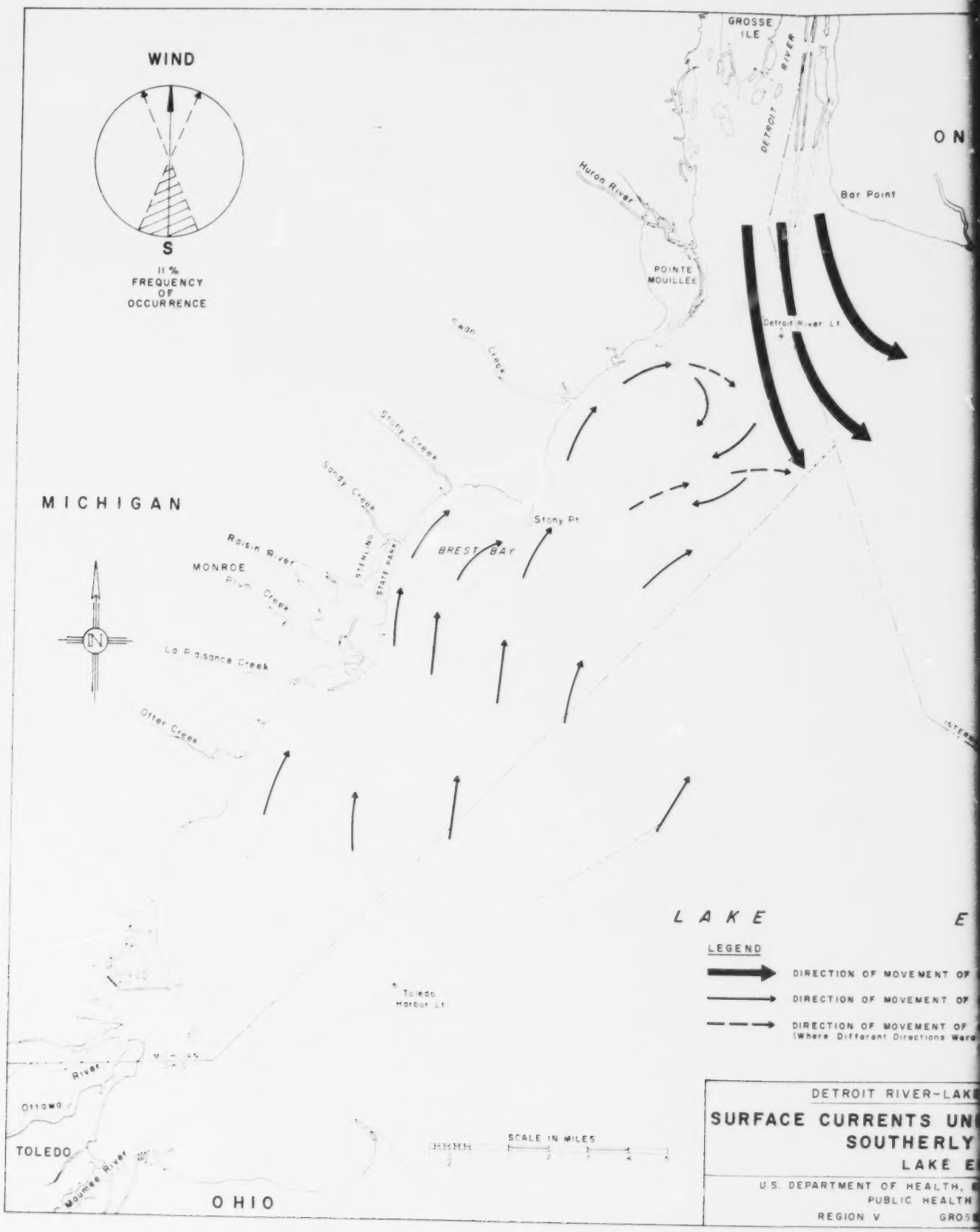
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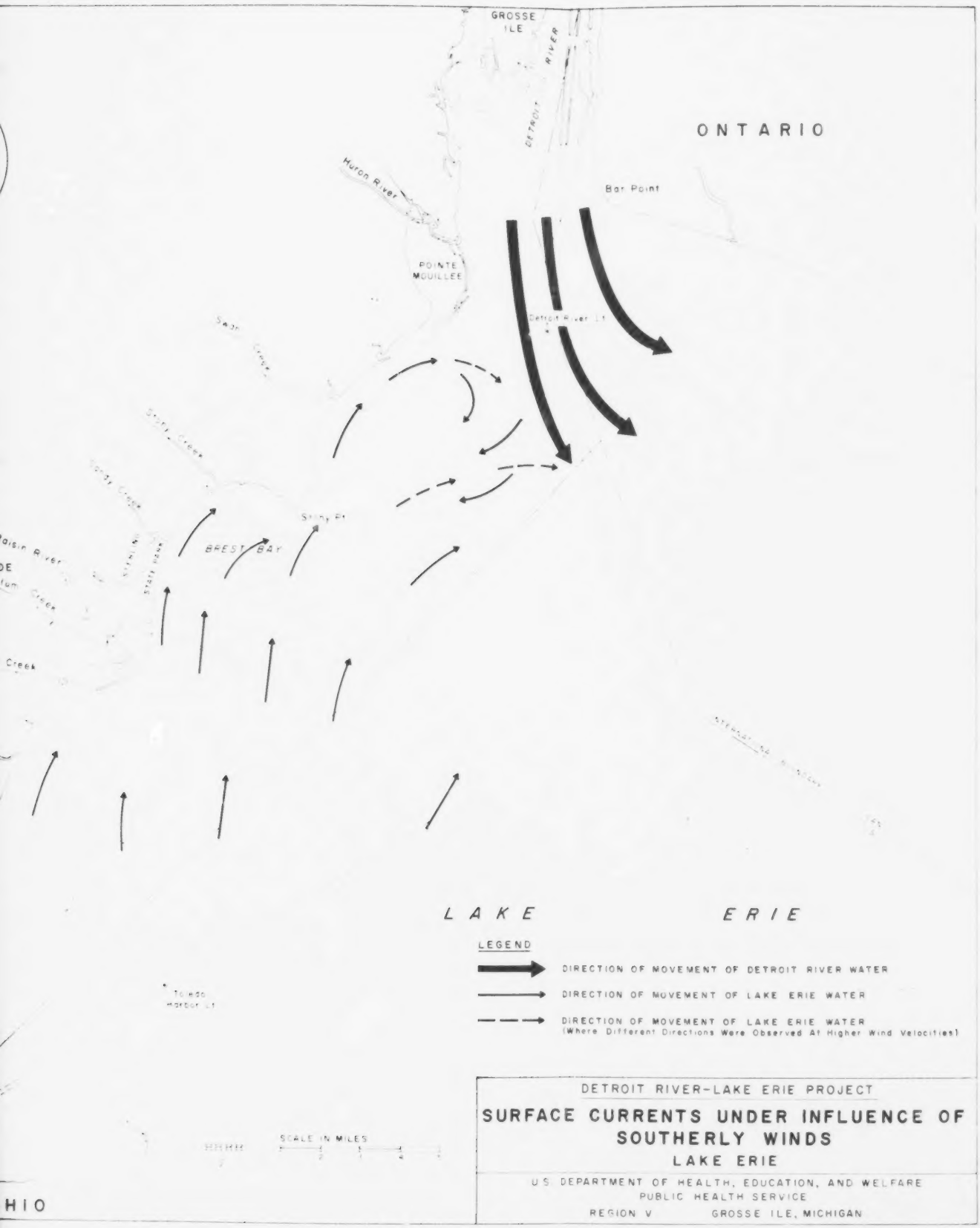

DETROIT RIVER-LAKE ERIE PROJECT

SURFACE CURRENTS UNDER INFLUENCE OF SOUTHERLY WINDS

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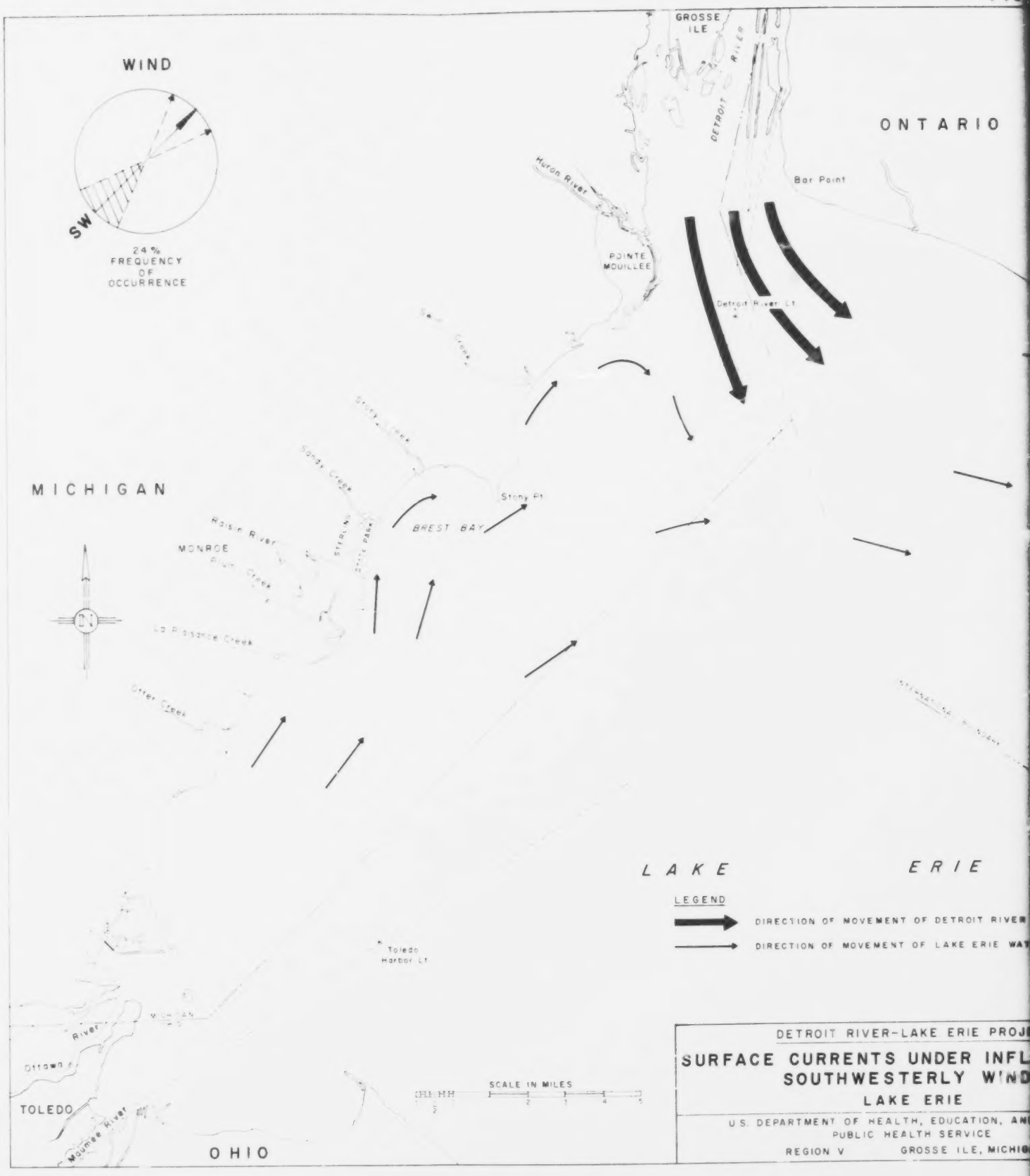
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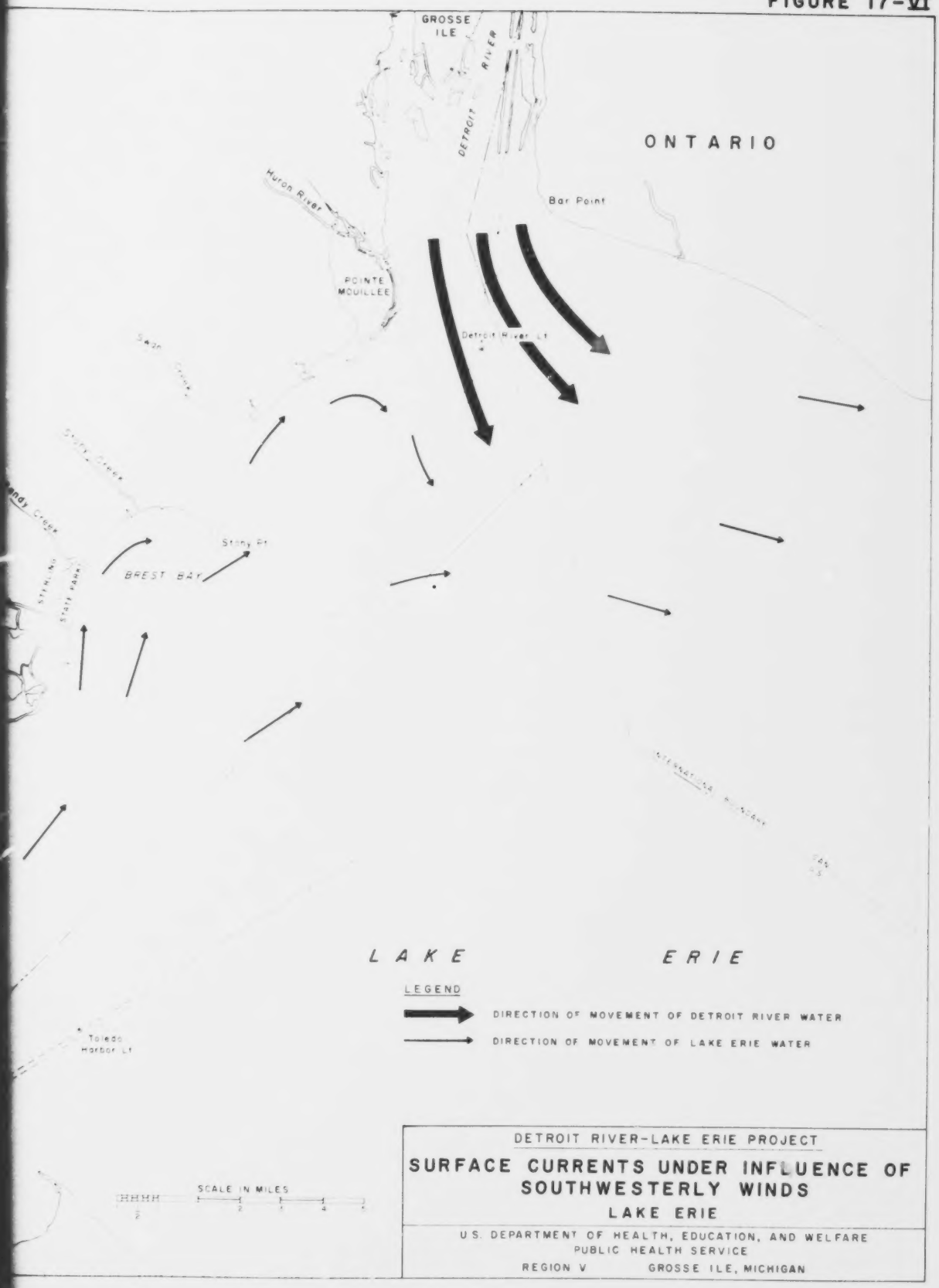
FIGURE 17-VI



DETROIT RIVER-LAKE ERIE PROJECT

SURFACE CURRENTS UNDER INFLUENCE OF SOUTHWESTERLY WINDS

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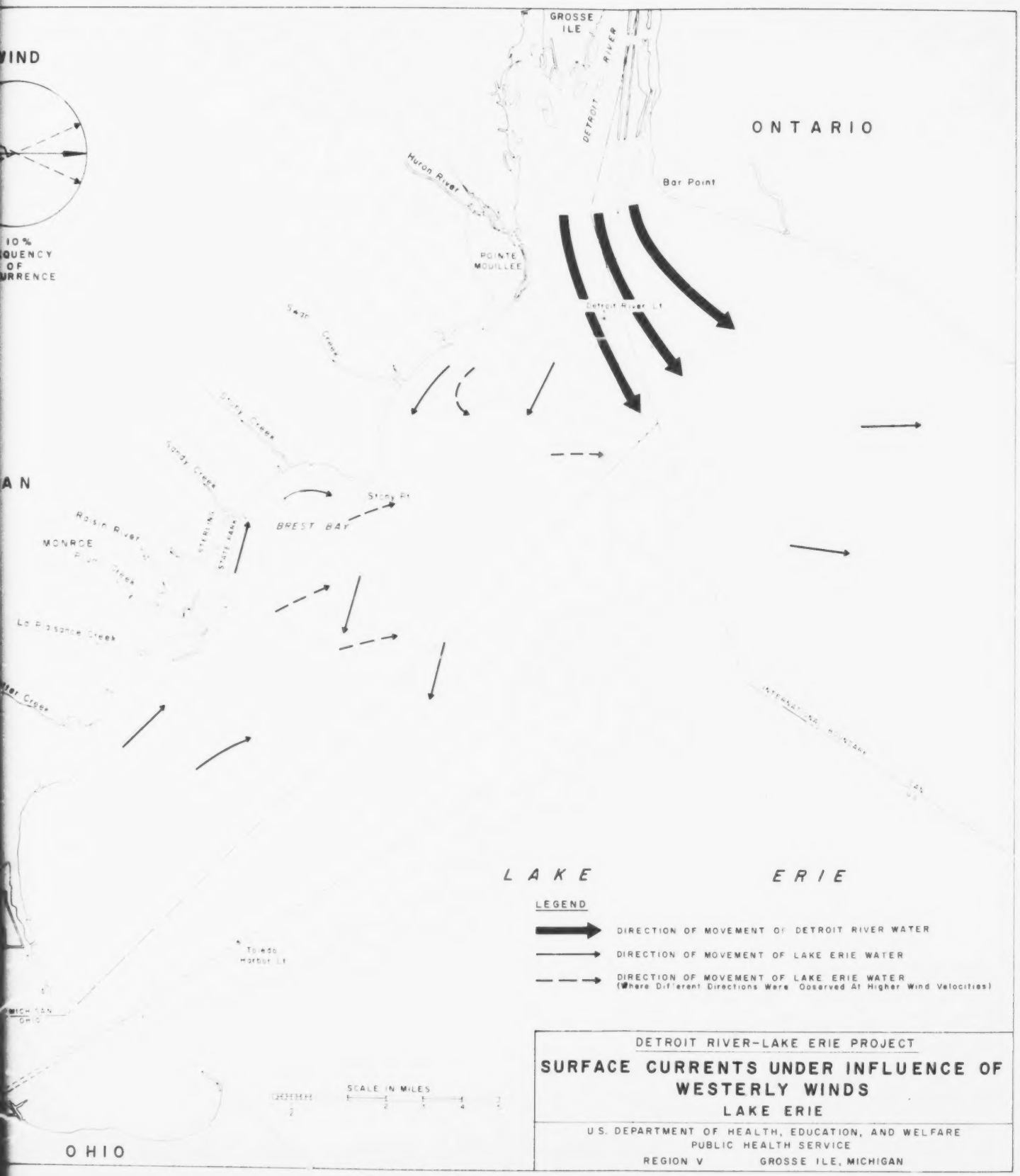

DETROIT RIVER-LAKE ERIE PROJECT

SURFACE CURRENTS UNDER INFLUENCE OF WESTERLY WINDS

LAKE ERIE

U.S. DEPARTMENT OF HEALTH, EDUCATION, AND WELFARE
PUBLIC HEALTH SERVICE
REGION V GROSSE ILE, MICHIGAN

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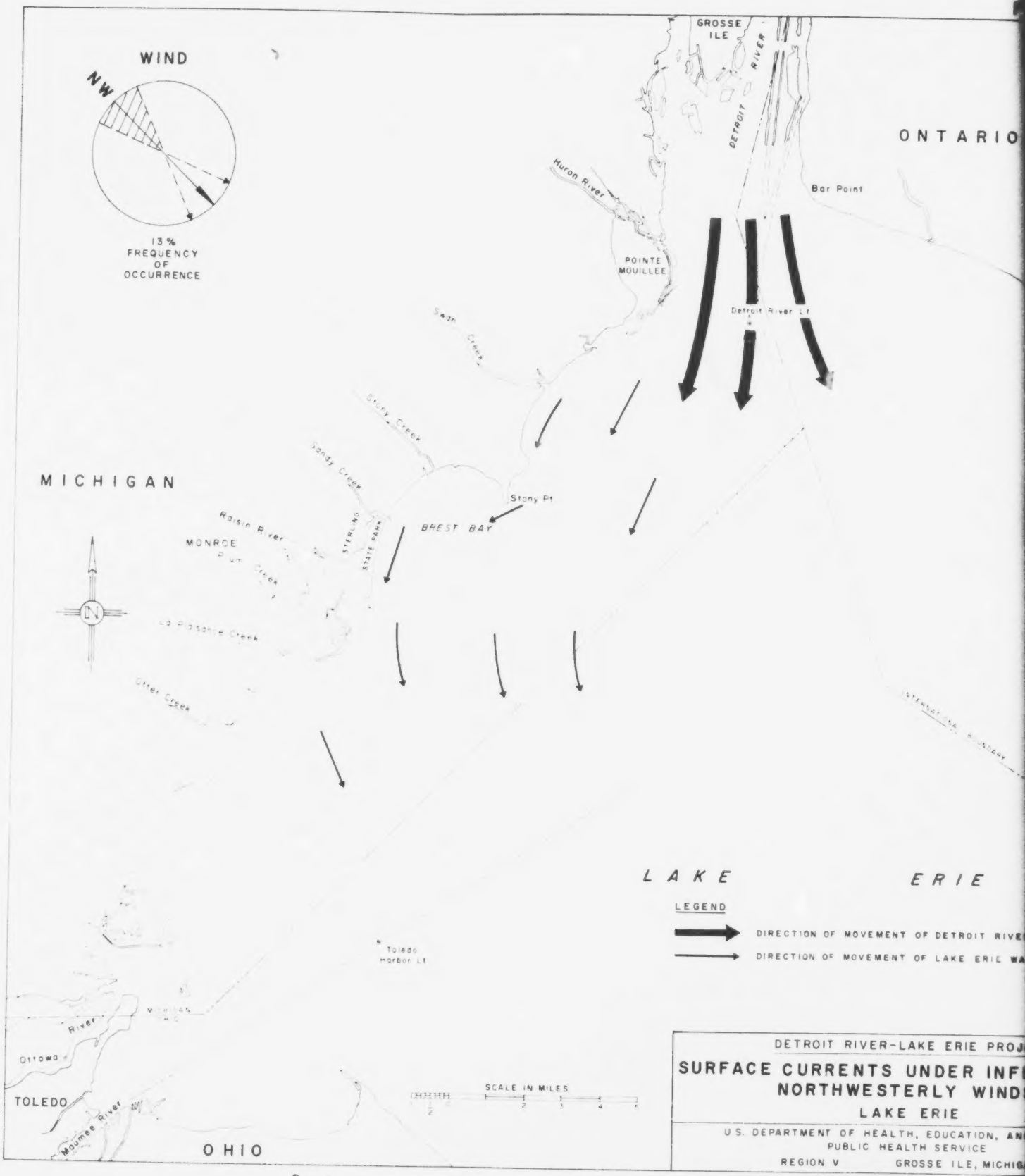
WIND
NW
13%
FREQUENCY
OF
OCCURRENCE
GROSSE
ILE
DETROIT RIVER
ONTARIO
Huron River
Bar Point
POINTE
MOUILLEE
Detroit River Lt
Swan Creek
Stony Creek
Sandy Creek
MICHIGAN
Stony Pt
BREST BAY
Raisin River
MONROE
STERLING
STATE PARK
Otter Creek
LAKE
ERIE
LEGEND
DIRECTION OF MOVEMENT OF DETROIT RIVE
DIRECTION OF MOVEMENT OF LAKE ERIE WA
Toledo
Harbor Lt
River
Ottawa
TOLEDO
Maumee River
OHIO
SCALE IN MILES
DETROIT RIVER-LAKE ERIE PROJ
SURFACE CURRENTS UNDER INFL
NORTHWESTERLY WIND
LAKE ERIE
U.S. DEPARTMENT OF HEALTH, EDUCATION, AN
PUBLIC HEALTH SERVICE
REGION V
GROSSE ILE, MICHIG

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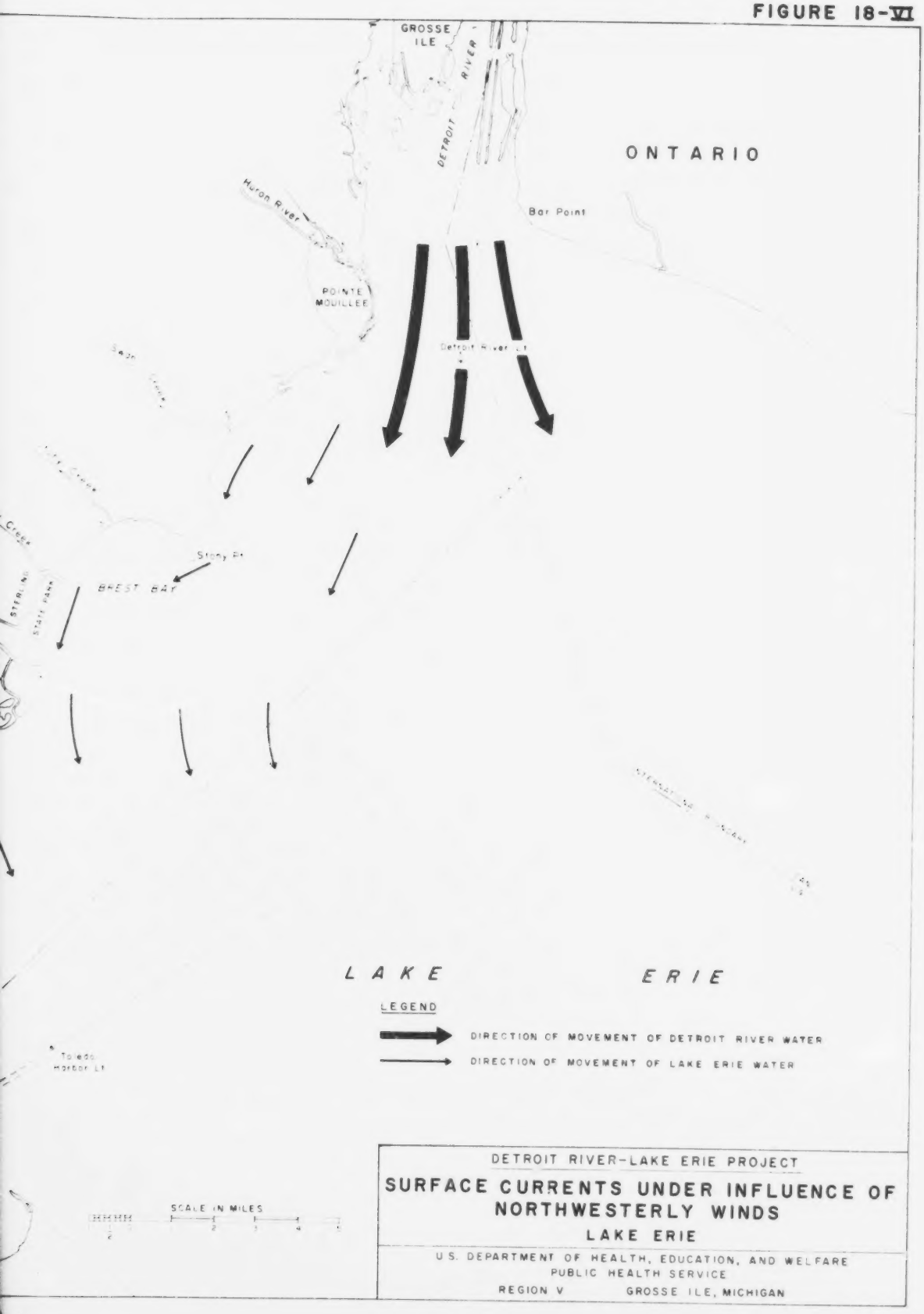
FIGURE 18-VI



DETROIT RIVER-LAKE ERIE PROJECT

SURFACE CURRENTS UNDER INFLUENCE OF NORTHWESTERLY WINDS

LAKE ERIE

U.S. DEPARTMENT OF HEALTH, EDUCATION, AND WELFARE
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REGION V GROSSE ILE, MICHIGAN

4. At Sterling State Park, northerly water movement may be expected to occur regularly for south-through-west winds. Thus, at least 40 to 45 percent of the time, Raisin River water can reach the beach areas to the north.

5. Direct water transport from the mouth of the Detroit River into Brest Bay is possible but probably occurs only rarely. Winds from the northeast and east, which occur approximately 20 percent of the time, could accomplish this if they blew steadily for two days or more.

Sterling State Park Beach Survey

Sterling State Park is a large recreational area located on Lake Erie just north of the mouth of the Raisin River. Among its facilities is a large expanse of bathing beach on Lake Erie. Approximately 1,200,000 people used the Park in 1959. Following investigation and evaluation by personnel of the Michigan Water Resources Commission and the Michigan Department of Health, and on their advice, the Sterling State Park was posted as unsafe for swimming by the Michigan Department of Conservation in August 1961. The State agencies, in a special report to the Michigan Water Resources Commission, listed several possible sources of waste capable of degrading the sanitary water quality of Sterling State Park, including (a) municipal waste effluent from Detroit, Wyandotte, Trenton, and Monroe, (b) overflow from combined sewers in the southeast Michigan area, (c) wastes from shorefront homes, and (d) industrial wastes from paper mills in the Monroe area.

The problem of water quality at the Sterling State Park and the waste sources and conditions which degrade this quality is complex and defies a simple solution. Average or geometric mean coliform values at this beach during the Project's duration indicated satisfactory water quality. However, grab samples collected after certain conditions of wind and rainfall showed exceptionally high coliform densities.

To explain these puzzling results a special investigation of the Park was undertaken by Project personnel with an engineering consultant called in for this purpose.

Description of Area

Sterling State Park is located on Brest Bay north of the Raisin River extending north to the mouth of Sandy Creek. The Park has approximately 7,400 feet of beach shoreline on Lake Erie, and inland waters directly adjacent to Sterling State Park have an area of approximately 245 acres. The water in the inland ponds adjacent to and within Sterling State Park is generally used for boating, fishing, and water skiing. Water taken for industries in the Monroe area passes through these ponds, the sources being Sandy Creek and Lake Erie water.

Water level changes in Lake Erie affect water movement into and out of the inland ponds, resulting in appreciable flows during these periods of rapid water level changes. It is not uncommon for the water level in Lake Erie to change 1 foot within a 6-hour period, which would result in an average water movement for this period of approximately 500 cfs. Since the water consumption of the industries using this water is approximately 200 cfs, the quality of water in the inland areas is partly dependent on the quality of water drawn in from the west end of Lake Erie.

Figure 19-VI shows the area covered by this investigation and the sampling points referred to in this report. Table 26-VI describes the sampling points and Table 27-VI lists the results of the bacteriological investigation of the Sterling State Park area, accompanied by pertinent weather data and remarks.

Present Water Quality Conditions

The bacteriological quality of water is expressed in terms of total coliform, fecal coliform, and fecal streptococcus density; the standard frequently accepted for swimming purposes, in terms of total coliforms, is 1,000 per 100 ml of water. Coliforms are associated with the enteric tract of warmblooded animals and are quite common in soil as a natural habitat. In waters free from pollution except from natural surface sources the density of fecal coliform will always be considerably lower than the total coliform density, usually about 5 per cent of the total. Consequently, high ratios of fecal coliform to total coliform indicate the presence of pollution from human wastes.

During April, May, and the first 2 weeks in June of 1963, the water quality on the beaches adjacent to Sterling State Park did not meet the standard for swimming. In July and August, however, coliform results were consistently low enough to permit safe swimming. When sampling was resumed late in October, the water quality was borderline, and during the latter part of November the bacteriological counts were again very high.

The quality of the water was poor throughout the survey conducted during April and the first week of May 1964. The highest coliform count was observed on April 16, when the coliform density at its southern end was 1,040,000 per 100 ml. Coliform counts in both the Raisin River on the southern end of the Park and in Sandy Creek at River Road on the northern end of the Park were, with only one or two exceptions, always in the five and six-figure range. Winds throughout the survey periods were observed from all quadrants, and the currents off the park travelled in both southerly and northerly directions. Currents at the mouth of Sandy Creek were flowing upstream and subsequently into the paper mills' intakes on all but two occasions during the sampling periods. On these two days, winds were moderate from the west, the Lake level was falling, and current in the Raisin River was flowing in and out about an equal number of times.

Overall values for the total coliforms at Sterling State Park ranged from less than 20 to 1,040,000 per 100 ml. At times, the percentage of fecal coliforms in the total coliform count approached 90, indicating the severity of the potential health hazard. Although fecal coliforms were generally less than 20 percent of total coliforms, the fecal coliform counts were over 1,000 per 100 ml on the majority of occasions. In addition, the ratio of fecal coliforms to fecal streptococci at the Park and Detroit Beach was usually high, over 1,000:1 on one occasion. Recent research studies have shown that when the ratio of fecal coliforms to fecal streptococci exceeds 2:1, the fecal bacteria have a human origin. Thus it is apparent that despite the fact that the majority of the coliforms in the waters at Sterling State Park were non-fecal during the 1964 survey, the remaining fecal bacteria are from a human origin and in high enough populations to cause a definite health hazard.

Fecal streptococcus counts during the 1964 survey were low, ranging from 10 per 100 ml to 840 per 100 ml. Counts in the Raisin River, although higher, were still relatively low. The highest count in the River during the survey was 1,340 per 100 ml. Fecal streptococcus counts in Sandy Creek reached a high of 5,500 per 100 ml on May 8, when the Creek was carrying the runoff of an early morning thunderstorm.

Although high bacteriological densities at the Sterling State Park beaches are of chief concern and were the cause of declaring the beach unsafe for swimming, other water quality problems exist. One particularly distressing condition during the summer months is the washing up on shore of floating, decaying organic material. This obnoxious material is the result of the deposition of settleable solids near the mouth of the Raisin River in waters devoid of dissolved oxygen because of the discharge of large quantities of oxygen-demanding wastes into this river. The settled material or sludge decays and, under anaerobic conditions, rises to the surface in a putrefied condition and floats out into Lake Erie and onto the bathing beach.

Sources of Pollution

In the Brest Bay area there are a number of sources of pollution which can affect water quality in Sterling State Park.

North of Sterling State Park a number of unsewered communities rely on septic tanks for waste disposal, the liquid products of which may find their way to drainage ditches and thereafter be discharged into Lake Erie by gravity or by stormwater pumping stations. Although the flow volume from these communities is small, because of the limited degree of treatment provided the concentration of pollutants can be excessively high. In some instances shorefront homes discharge septic tank effluent directly into the Lake. Homes not on shorefront property often discharge septic effluent to absorption tiles. The effectiveness of this method of disposal is limited by the absorptiveness of the soil and the groundwater level. Some absorption tile fields are directly connected to drainage ditches or storm sewers to be discharged into Lake Erie. A stormwater collection system carries the water to pumps from where it is discharged intermittently to Lake Erie at stormwater pumping stations.

Several storm pumps located in the Detroit Beach area directly north of Sterling State Park were sampled to determine the quality of water discharged. Most of the pumps discharge only during rainy periods; consequently, only a limited number of samples were obtained. The results are tabulated in Table 28-VI and show that the bacteriological quality of their discharge was poor on most occasions. The pump located on the southern edge of Detroit Beach (see Figure 19-VI) operated in both wet and dry weather. Coliform results ranged from 740,000 during a rain to 6,000 during dry weather. Other pumping stations showed coliform counts ranging from 790,000 to 116,000. Fecal coliform for all stations averaged below 15 percent and fecal streptococci ranged from a low of 210 to a high of 49,000.

Other sources of pollution are the wastes of seven major industries and the domestic waste from the City of Monroe, all of which discharge into the Raisin River. The Raisin River discharges into Lake Erie approximately 1 mile south of the Sterling State Park area.

The City of Monroe provides primary treatment and chlorinates the effluent from the middle of May to the middle of September. Surveys show that chlorination can reduce the coliforms in the effluent to less than 10 per 100 ml. Without chlorination, effluent coliform values were as high as 110,000,000 per 100 ml. Flow through the plant usually ranges from 2 to 6 MGD. The collection system is capable of carrying 16 MGD to the sewage treatment plant, however, and during periods of excessive rainfall large quantities of untreated waste are discharged to the River. In terms of BOD loading, the wastes discharged from the paper industries have a population equivalent of approximately 225,000. Sampling surveys were made to determine the bacteriological quality of the influent and effluent waters from the following paper mills:

Consolidated Paper Company - North Side Division
Consolidated Paper Company - South Side Division
Monroe Paper Products Company
Union Bag-Camp Company - River Raisin Division

The results of these surveys are tabulated separately in Table 29-VI.

Hydrologic Factors Influencing Water Quality

a. Currents. Current observations were made at three points along Sterling State Park beach in April and May 1964. Dye was placed in the water at a depth of about 2 feet and its direction and velocity of movement observed on 14 different days under a variety of wind conditions.

The direction of water movement is influenced primarily by wind friction, but is modified in direction and velocity at the inshore areas along the beach. Sterling State Park has a typical sandy beach with constantly changing bar patterns running in random fashion both parallel and perpendicular to the shoreline. At each end of the beach a pier extends into the lake about 200 feet, deflecting current movements somewhat. Seiche action on Lake Erie is practically continuous, and when the surface level is changing the water near the shore shows considerable movement shoreward or lakeward.

Nevertheless, except in the case of easterly winds, the general pattern of flow was evident from the inshore stations studied. (Winds from easterly quadrants cause onshore water movement, resulting in variable flow, and no distinct patterns of northward or southward alongshore currents.) Southerly winds and westerly winds produced northerly currents along the beach. Northwesterly winds produced southerly currents and northerly winds, which did not occur during the survey period, would likely also produce southerly currents.

In order to expand the survey data to give an indication of the percent of time that various currents could be expected, a comparison was made with long-term wind data. The nearest available station record is from Grosse Ile, as shown in U.S. Weather Bureau Technical Paper 35, "Climatology and Weather Services, Great Lakes and St. Lawrence Seaway." The general trend of current movements and related winds observed during the survey in April and May 1964 was compared to the winds recorded on a monthly and annual basis in the U.S. Weather Bureau publication.

For the 10-month ice-free period (March through December) the water could be expected to move along the beach in a northerly direction about 45 percent of the time, in a southerly direction about 20 percent of the time, and be variable and unpredictable about 35 percent of the time. In June, July, and August, when beach use is maximum, northerly currents can be expected about 40 percent of the time, southerly currents about 15 percent of the time, and variable and unpredictable currents about 45 percent of the time, including about 15 percent of the time when calm conditions prevail.

Water movements, in a northerly direction create a potential problem from Raisin River water, and in a southerly direction a potential problem from storm pumps, tributaries, and other sources to the north of the Park. Variable movements involve hazards from either direction. Whether or not the problem condition materializes depends on other factors such as rainfall, runoff, and seiche action which introduce the pollutant into the moving mass of Lake water.

b. Railfall has an effect on three potential sources of pollution in the Sterling State Park area. These are: (1) the stormwater pumps from the Detroit-Woodland Beach areas, (2) Sandy Creek, (3) the Raisin River. These sources are discussed individually and jointly and sampling results during periods of rainfall given.

Bacteriological results from random samples taken at stormwater pumping stations during the 1964 survey show that they are definitely potential sources of coliforms. Coliform counts as high as 780,000 per 100 ml were found at the Woodland Beach pumping station during the storm of March 25 when 1.55 inches fell at the Toledo Airport. With the possible exception of the stormwater pumping station located on the southern edge of Detroit Beach, pump sites were usually dormant except during periods of rain.

Sandy Creek contains relatively high coliform counts during periods of high runoff. The highest flow recorded in the Creek during the survey was about 60 cfs on April 29, after thundershowers had passed through the area, compared to a monthly dry weather flow of approximately 5 cfs. The coliform count in the Creek on April 29 was 24,000 per 100 ml. Another period of relatively high runoff occurred on May 8, when the flow reached about 20 cfs and the coliform count was 77,000 per 100 ml.

The Raisin River is grossly polluted at all times, but its highest coliform counts occurred after the rain of May 8, reaching 470,000 per 100 ml. The Raisin River also receives a significant load of pollution from stormwater overflows, discussed specifically in the section on the Raisin River.

During the 1964 survey, the first rainfall occurred on April 21. Samples were collected the day of the rain as well as on the preceding and following days. The coliform counts at Detroit Beach, most affected by stormwater pumping, increased from a high count of 10,000 per 100 ml on the day before the rain to 14,000 per 100 ml on the day of the rain. The next 2 days' counts showed a drop of about 50 percent each day. The Sterling State Park sampling station closest to Detroit Beach showed a decrease in coliform count during the day of the rain with a slight increase on the following day, and then a further decrease on the next day. Currents at the mouth of Sandy Creek were upstream, and because of this, the potential effects on the Park of bacterial pollution from the Detroit-Woodland Beach area were probably lessened, some of the polluted Lake water being drawn into the creek.

Rain fell again on April 27, 28, 29, and 30. On April 29 there were coliform counts of 14,000 per 100 ml at Detroit Beach just north of the mouth of Sandy Creek, and 10,000 per 100 ml at Sterling State Park just south of Sandy Creek. The flow in Sandy Creek was 60 cfs on April 29. The direction of flow at the mouth of the creek was not determined at this time, but it was probably lakeward, with a runoff so large. Currents off the Park were northerly and would tend to move effluent from Sandy Creek northward towards Detroit Beach.

A thunderstorm passed through the area early on May 8. Samples taken on this day show high coliform counts on all beach stations, decreasing in magnitude at stations farther from the mouth of the Raisin River. The coliform count at Detroit Beach on this date was 47,000 per 100 ml, only exceeded on one other occasion during the survey. Since the Lake currents were northerly and because the direction of flow from Sandy Creek was not noted, it is impossible to know if the high count was due to pollution from Sandy Creek or the Raisin River.

In general, Sandy Creek and the Detroit-Woodland Beach pump houses are sources of pollution following rain, while the Raisin River is a more constant polluter of the beaches. If the Lake currents opposite the beaches are northerly, as during the rains of April 29 and May 8, pollution from the first sources is probably swept northward having little effect on the Park; in this event, the Raisin River almost certainly contributes waste to the Park waters. If the current is southerly and Sandy Creek flows lakewards, the pollution from the Detroit-Woodland Beach area and the Creek would be sufficient to cause serious contamination of the waters off Sterling State Park, even without the effect of the Raisin River.

Summary of Findings

1. The water quality at the beaches in the Brest Bay area is primarily affected by local sources of pollution rather than by the Detroit River.

2. The Raisin River is the primary cause of pollution at Sterling State Park beach.

3. Wind-driven water currents can be expected to move along the Park beach in a northerly direction 45 per cent of the time, in a southerly direction 20 per cent of the time, and variably and unpredictably about 35 per cent of the time. When water currents move along the beach in a northerly direction the effect of the Raisin River is predominant at the Park. When the currents move in a southerly direction, overflow from stormwater pumping stations, polluted tributaries, and shorefront houses north of Sterling State Park have the predominant effect on water quality at the beach.

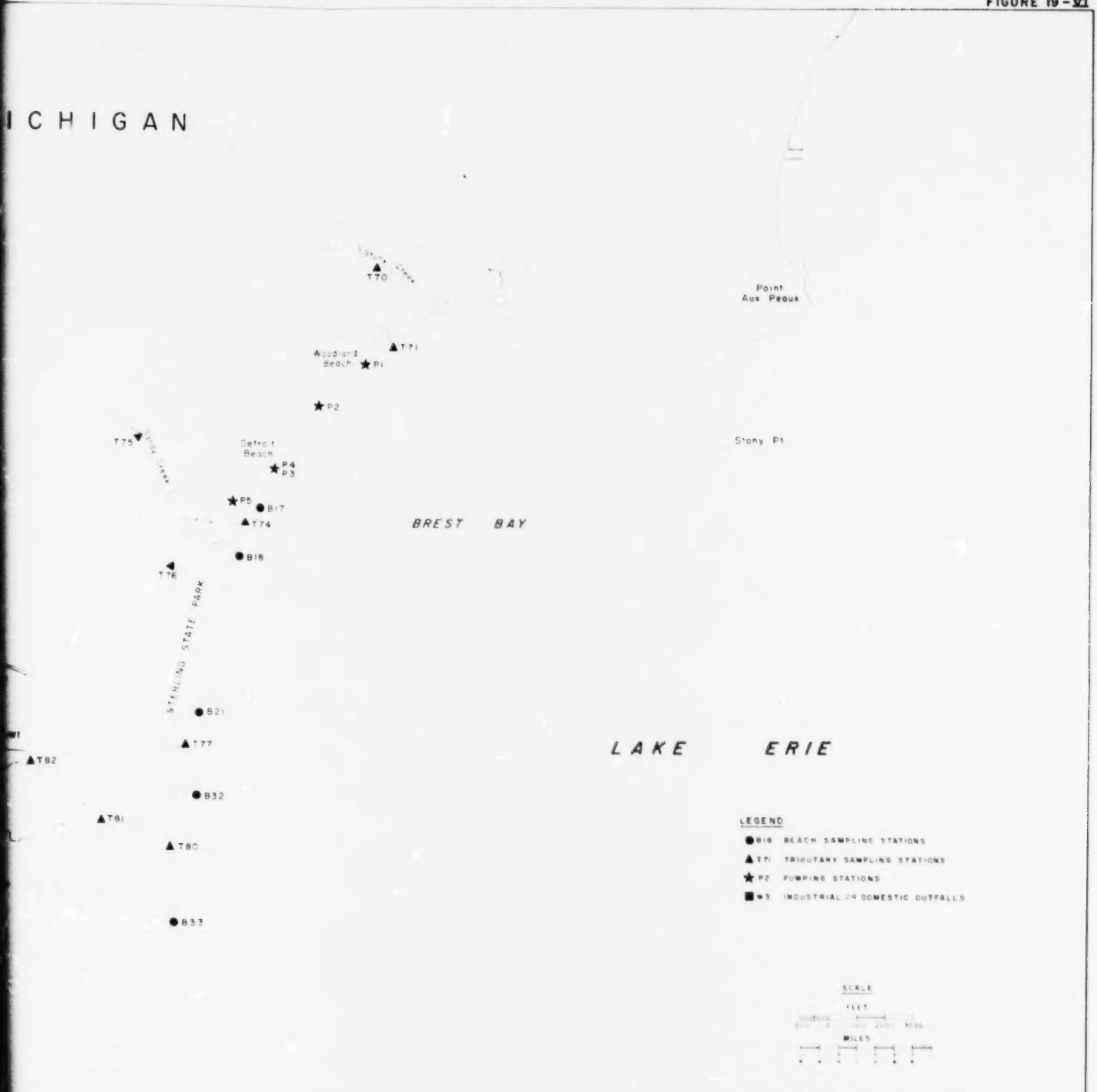
RIVER

AREA LOCATION MAP
MICHIGAN
LAKE ST CLAIR
ONTARIO
LAKE ERIE
TOLEDO

MICHIGAN

315 b

FIGURE 19-VI



DETROIT RIVER-LAKE ERIE PROJECT

LOCATION OF SAMPLING STATIONS
STERLING STATE PARK SURVEY

U.S. DEPARTMENT OF HEALTH, EDUCATION, AND WELFARE
PUBLIC HEALTH SERVICE
REGION V GROSSE ILE, MICHIGAN

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TABLE 26-VI. DESCRIPTION OF SAMPLING POINTS
STERLING STATE PARK SURVEY

T80	Raisin River at the mouth
T81	Raisin River 0.5 miles upstream from the mouth
T82	Raisin River 1.13 miles upstream from the mouth
T70	Stony Creek at River Road
T71	Mouth of small boat harbor about 1,500 feet south of the mouth of Stony Creek
T74	Mouth of Sandy Creek
T75	Sandy Creek at River Road
T76	Culvert pipe under the road crossing the lagoon west of Sterling State Park's bathing beach
T77	Mouth of the stream on the extreme southern end of Sterling State Park's bathing beach
B17	Detroit Beach north of Sandy Creek
B18	Sterling State Park (northern end)
B21	Sterling State Park (southern end)
B32	Midway between the Raisin River and Sterling State Park
B33	2,500 feet south of the Raisin River
P1	Woodland Beach Pumping Station
P2	Grand Beach Pumping Station
P3)	Detroit Beach twin pumping station
P4)	
P5	Detroit Beach Pumping Station along Sandy Creek
W1	Mason Run
W2	Monroe Sewage Treatment Plant outfall
W3	Consolidated Paper Company - south outfall
W4	Consolidated Paper Company - north outfall
W5	Monroe Paper Products outfall

4. The Raisin River is bacteriologically polluted throughout the year, the primary sources of this contamination being the four paper mills in Monroe and the Monroe Sewage Treatment Plant. Industrial sources contribute most of the bacteria during summer months, when the municipal effluent is chlorinated (June through September), and the municipal plant is the leading contributor during the remainder of the year.

5. Septic tank effluents enter Lake Erie to a limited extent directly from waterfront houses north of the Park, and to a much greater extent indirectly from drainage ditches and stormwater collection systems. Discharges occur primarily during periods of heavy rainfall and runoff.

6. Stormwater runoff itself often contains high densities of coliform, and discharge of stormwater to the Lake or its tributaries creates a health hazard when currents carry this contaminated water to beach areas.

7. Discharge from Sandy Creek threatens water quality at the north end of the Park. Because of the reverse flow in the Creek at its mouth due to water withdrawal by several major industries, the effect of these discharges on the Park is felt only during periods of high runoff or during rapid fall of the Lake water level.

8. Waste discharges from Stony Creek and above, including a small nearby boat inlet, carry high coliform densities, but the volume of flow is small. Because of the prevailing currents, these sources probably affect water quality on local beaches rather than at Sterling State Park.

9. Water quality at the Lake sampling stations opposite Brest Bay was generally satisfactory for swimming, while beach water at Sterling State Park is erratically affected by coliform counts too high to permit safe swimming.

TABLE 27-VI. RESULTS OF BACTERIOLOGICAL INVESTIGATION OF STERLING STATE PARK BATHING BEACHES APRIL - MAY, 1964

Date	Sta.	Gen. Wind Dir.	Current Direction off Park	Remarks and Weather Observations	Total Coliform Density Organisms/100ml	Fecal Coliforms		Fecal Strep Org/100ml	Ratio F. Col. / F.Strep
						Percent	Per 100ml		
4/6/64	T75				35,000	5	1,750	180	10:1
	B17				1,600	12	190	70	3:1
	T74	Lt. S	NNE	Partly cloudy with wind up to 10 knots Light rain	4,000			100	
	B18				1,700	10	170	40	4:1
	B21				2,100	10	210	70	3:1
	T77				1,000			20	
	B32				1,100	10	110	10	11:1
4/7/64	T75				1,200	20	240	180	1:1
	B17	Lt to mod. W		Cloudy with no significant rain	800				
	T74				300			60	
	B18				2,500	25	620	110	6:1
	B21				8,400	45	3,800	360	11:1
	T77				6,600	35	2,300	300	8:1
	B32				2,400	5	120	70	2:1
	T80				51,000	25	12,500	460	27:1
	T81				58,000	40	23,000	630	36:1
	T82				71,000	45	32,000	550	58:1
	B33				24,000	25	6,000	490	12:1
4/8/64	T75				10,000	30	3,000	290	10:1
	B17				4,100	15	615	40	15:1
	T74			Cloudy with light rain and winds up to 20 knots Flow is outward at T74 and T77	8,300	10	830	120	7:1
	B18	Mod. W			5,900	25	1,500	20	75:1
	B21				6,600	35	2,300	40	57:1
	T77				6,300	50	3,150	40	79:1
	B32				1,000	8	80	10	8:1
	T80				53,000	50	26,500	840	32:1
	T81				35,000	20	7,000	900	8:1
	T82				31,000	45	14,000	750	22:1
	B33				40,000	10	4,000	840	5:1

TABLE 27-VI. RESULTS OF BACTERIOLOGICAL INVESTIGATION OF STERLING STATE PARK BATHING BEACHES APRIL - MAY, 1964 (CONTINUED)

Date	Sta.	Gen. Wind Dir.	Current Direction off Park	Remarks and Weather Observations	Total Coliform Density Organisms/100ml	Fecal Coliforms		Fecal Strep Org/100ml	Ratio F. Col. / F.Strep.
						Percent	Per 100ml		
4/13/64	T75			Cloudy with	11,000	5	550	50	11:1
	B17			wind gusts up	83,000	5	4,150	240	17:1
	T74	Strong		to 30 knots.	95,000	5	4,750	170	28:1
	B18	S	N	No significant	106,000	15	16,000	290	55:1
	B21			rain for prev-	190,000	25	47,500	310	153:1
	T77			ious 3 days.	95,000	20	19,000	210	90:1
	B32				110,000	25	27,500	370	75:1
	T80				132,000	5	6,500	460	14:1
	T81				92,000	10	9,200	780	12:1
	T82				45,000	30	13,500	840	16:1
	B21				380,000	5	19,000	250	76:1
4/14/64	B21	Strong S		No sign rain for last 4 days	88,000	5	4,400	100	44:1
4/15/64	B21	Mod W		No rain	220,000	10	22,000	10	2200:1
4/16/64	B21	Mod SSE		No rain	1,040,000	10	104,000	270	385:1
4/20/64	T75			Cloudy with	33,000	10	3,300	340	9:1
	B17	Mod		light rain.	10,000	10	1,000	70	14:1
	T74	E	NE	Currents on	65,000	5	3,250	100	32:1
	B18		to	north edge	52,000	5	2,600	40	65:1
	B21		SE	of Park	16,000	5	800	30	27:1
	T77			tended to go	40,000	5	2,000	60	33:1
	T82			NE while on	66,000	5	3,300	270	12:1
	T81			the southern edge they	49,000	10	4,900	350	14:1

TABLE 27-VI. RESULTS OF BACTERIOLOGICAL INVESTIGATION OF STERLING STATE PARK BATHING BEACHES APRIL - MAY, 1964 (CONTINUED)

Date	Sta.	Gen. Wind Dir.	Current Direction off Park	Remarks and Weather Observations	Total Coliform Density Organisms/100ml	Fecal Coliforms		Fecal Strep Org/100ml	Ratio F. Col. / F. Strep.
						Percent	Per 100ml		
4/20/64 (cont.)	T82			tended to go SE. Winds ranged up to 18 knots	84,000	10	8,400	260	32:1
	B33				71,000	10	7,100	180	40:1
4/21/64	T75	E to SE	SE to NE	Moderate rain in morning. Winds 5 to 10 knots shifting from E to SE. No significant rain in previous two days. Currents southerly except for north edge of park.	24,000	5	1,200	480	3:1
	B17				14,000	10	1,400	50	28:1
	T74				7,000	5	350	40	9:1
	B18				18,000	10	1,800	40	45:1
	B21				11,000	10	1,100	20	55:1
	T77				12,000	5	600	10	60:1
	T80				180,000	15	27,000	640	42:1
	T81				122,000	5	6,100	940	7:1
	T82				160,000	15	24,000	1,180	20:1
4/22/64	T75	Mod. WSW	NE	75% Sky cover. Winds blowing from 10 to 20 knots. No rain. Flow is outward at T77 and T74 on this date which is unusual.	10,800	25	2,450	200	12:1
	B17				7,300	7	500	60	8:1
	T74				18,000	5	900	40	22:1
	B18				22,000	15	3,300	40	82:1
	B21				32,000	10	3,200	40	80:1
	T77				83,000	10	8,300	140	59:1
	B32				16,000	25	4,000	100	40:1
	T80				88,000	35	31,000	480	65:1
	T81				120,000	25	30,000	500	60:1
	T82				117,000	35	41,000	1,260	33:1
	B33				2,000	10	200	40	5:1

TABLE 27-VI. RESULTS OF BACTERIOLOGICAL INVESTIGATION OF STERLING STATE PARK BATHING BEACHES APRIL - MAY, 1964 (CONTINUED)

Date	Sta.	Gen. Wind Dir.	Current Direction off Park	Remarks and Weather Observations	Total Coliform Density Organisms/100ml	Fecal Coliforms Percent	Fecal Coliforms Per 100ml	Org/100ml	Ratio F. Col. / F. Strep.
4/23/64	T75				3,800	25	950	180	5:1
	B17			25% Sky	4,800	20	960	20	48:1
	T74			cover, Winds	4,800	15	720	10	72:1
	B18			blowing at	7,800	5	390	10	39:1
	B21	Lt.		5-10 knots.	5,100	10	510	10	51:1
	T77	SE	NNE		3,100	30	930	10	93:1
	B32				5,500	10	550	10	55:1
	T80			No rain	42,000	15	6,400	720	9:1
	T81				58,000	20	10,600	440	24:1
	T82				58,000	40	23,000	1,340	17:1
	B33				49,000	15	7,400	60	123:1
4/27/64	B21	Lt.		Cloudy with	5,000	20	1,000	10	100:1
	T80	ESE	N	rain, wind 7-10 knots	62,000	9	5,600	620	9:1
4/28/64	B21	Lt. S	N	Partly cloudy Wind 2-4 knots	39,000	10	3,900	60	65:1
4/29/64	T75				24,000				
	B17	Lt.		Cloudy with	14,000			520	
	B18	S	N	Wind 8 knots	10,000	20	2,000	20	100:1
	B21				35,000			10	
	T80				89,000	5	4,400	320	14:1
	T81				116,000	5	5,800	1,140	5:1
	T82				109,000	5	5,400	1,280	4:1
4/30/64	B21	Lt. ENE	S	Rain; wind 6-8 knots	72,000	5	3,600	260	14:1

TABLE 27-VI. RESULTS OF BACTERIOLOGICAL INVESTIGATION OF STERLING STATE PARK BATHING BEACHES APRIL - MAY, 1964 (CONTINUED)

Date	Sta.	Gen. Wind Dir.	Current Direction off Park	Remarks and Weather Observations	Total Coliform Density Organisms/100ml	Fecal Coliforms		Fecal Strep Org/100ml	Ratio F. Col. / F. Strep.
						Percent	Per 100ml		
5/4/64	B21				11,000	10	1,100	100	11:1
5/5/64	T75				5,900	5	290	80	4:1
	B17	Lt.		Mostly fair	1,000	10	100	10	10:1
	T74	SE	SE	with wind	5,000	-	-	20	
	B18			5-10 m.p.h.	600	-	-	10	
	B21			Flow at ex-	2,100	10	210	10	21:1
	T77			treme north	900	10	90	10	9:1
	B32			end of Park	4,400	5	220	10	22:1
				was northerly					
5/6/64	B21	Lt. SE	NE	Mostly fair with about 10 m.p.h. winds	1,300	6	80	100	0.8:1
5/7/64	T75				3,800	10	380	160	2:1
	B17	Mod			31,000	10	3,100	10	310:1
	T74	SSW	N	Fair skies	7,100	10	710	10	71:1
	B18			with no rain	26,000	10	2,600	10	260:1
	B21			for several	31,000	10	3,100	10	310:1
	T77			days	39,000	10	3,900	10	390:1
	B32				54,000	10	5,400	10	340:1
	T80				86,000	10	8,600	70	122:1
	T81				250,000	10	25,000	300	83:1
	T82				360,000	10	36,000	340	106:1
	B33				63,000	5	3,100	40	77:1

TABLE 27-VI. RESULTS OF BACTERIOLOGICAL INVESTIGATION OF STERLING STATE PARK BATHING BEACHES APRIL - MAY, 1964 (CONTINUED)

Date	Sta.	Gen. Wind Dir.	Current Direction off Park	Remarks and Weather Observations	Total Coliform Density Organisms/100ml	Fecal Coliforms Percent	Fecal Coliforms Per 100ml	Fecal Strep Org/100ml	Ratio F. Col. / F. Strep.
5/8/64	T75	Lt		Thunderstorm	77,000	5	3,800	5,500	0.7:1
	B17	to		passed through	47,000	5	2,300	100	23:1
	T74	mod	N	the area about	84,000	5	4,200	100	42:1
	B18	S		six hours be-	66,000	5	3,300	100	33:1
	B21			fore sampling.	120,000	5	6,000	100	60:1
	T77			Winds during	75,000	5	3,800	100	38:1
	B32			sampling were	45,000	5	2,300	100	23:1
	T80			about 10-12	320,000	5	16,000	100	160:1
	T81			m.p.h.	400,000	5	20,000	100	200:1
	T82				470,000	5	23,000	100	230:1
	B33				1,300	10	130	100	1:1

TABLE 28-VI. RESULTS OF BACTERIOLOGICAL INVESTIGATION OF OVERFLOW FROM STORM PUMPING STATIONS NEAR STERLING STATE PARK

Date	Sta.*	Total Coliform Organisms/100ml	Fecal Coliform Organisms/100ml	Fecal Strep Organisms/100ml
1964				
3/25	P1	780,000	39,000	18,000
	P3	160,000	24,000	29,000
	P5	740,000	37,000	48,000
4/6	P5	107,000	5,300	220
4/7	P5	54,000	5,400	1,000
4/13	P5	6,000	-	210
4/21	P5	86,000	4,300	11,840
4/23	P5	116,000	17,400	5,960
4/29	P1	410,000	20,500	48,000
	P2	170,000	17,000	41,200
	P5	63,000	3,150	9,400
5/7	P3	490,000	49,000	1,730
5/8	P3	400,000	40,000	44,800

* See Figure 19-VI

TABLE 29-VI. SUMMARY OF BACTERIOLOGICAL INVESTIGATION OF INDUSTRIAL WASTE SOURCES NEAR STERLING STATE PARK. APRIL - MAY, 1964

Industry	Geometric Mean Densities			
	Estimated Discharge (MGD)	Total Coliforms Org/100ml	Fecal Coliforms Org/100ml	Fecal Strep Org/100ml
Effluent				
Consolidated Paper Co.				
South Plant	7.0	219,000	17,600	630
North Plant	1.0	215,000	42,300	5,520
Monroe Paper Products	2.2	3,370,000	730,000	5,630
Mason Run (Consolidated North & Union Bag)	11.0	98,000	18,000	1,040
Weighted Mean Effluent Samples	21.2 (total)	484,000	92,800	1,570
Influent				
Consolidated Paper Co.	-	14,600	1,800	56
Monroe Paper Products	-	1,570	100	80

Maple-Milleville Beach Surveys

A special study was made September 3 - 5, 1963, to determine the influence of the Trenton Channel upon water quality at the Maple and Milleville bathing beaches, located near the mouth of the Detroit River and designated as regular stations B1 and B2 (see Figures 2-I and 3-I).

These are the findings:

1. Water adjacent to Maple and Milleville beaches is unsafe for swimming, with coliform values during the three-day survey ranging from 600 to 2,600 organisms per 100 ml and fecal coliform values ranging from 20 to 800 organisms per 100 ml. The geometric mean coliform density at these beaches during the Project was 2,000 organisms per 100 ml.

2. Water quality adjacent to the two beaches is of much higher bacterial quality than water further offshore. This same phenomenon is demonstrated by comparison of Estral, Dewey and Stony Point Beaches and adjacent Lake Erie bacteriological results (geometric means for the duration of the Project). In this case the beach samples are approximately 25 percent of the magnitude of the adjacent lake stations. The beach and Lake stations are shown in Figure 2-I as numbers B3, B4, L3, L5, L6, and L7. (In the Lake Erie bathing beaches from Stony Point south to the Michigan-Ohio state line coliform densities adjacent to the beaches were higher than at corresponding Lake stations.)

3. The Detroit River is the main influence on bacterial water quality at bathing beaches from the mouth of the River to Stony Point. Below this point direct pollution and other tributaries have the greater influence on bacteriological water quality.

Rooted Aquatic Vegetation Study

Rooted aquatic vegetation was abundant during the summer of 1964 along the shoreline of Grosse Ile in the Detroit River and Lake Erie. Growths were prolific this year primarily due to low water levels: the waters near the shore are shallower, allowing greater light penetration to stimulate growth. Warmer summer temperatures and a ready supply of essential plant nutrients (soluble phosphorus and inorganic nitrogen) from waste discharges in the adjacent waters or bottom muds also contribute to this problem.

Two genera of rooted aquatic vegetation were observed--Potamogeton and Vallisneria--and intertwined among these rooted aquatics were growths of the attached green alage, Cladophora and Hydrodictyon. These growths are not only undesirable from an aesthetic standpoint, but also interfere with boating by fouling propellors. Later in the season the vegetation dies and decomposes, accompanied by strong odors.

The phenomenon was surveyed only in the last months of Project operation and not incorporated into the section on biology. Solutions to the problem include abatement of pollution from sources containing significant amounts of phosphorus and nitrogen compounds.

INTERFERENCES WITH WATER USES

Municipal Water Supply

Monroe is currently the only city taking municipal water from the Michigan waters of Lake Erie.

Algal growths in Lake Erie have caused serious taste and odor problems in the public water supply of the City of Monroe, and in 1950 forced the Monroe waterworks to move its intake point in an attempt to obtain purer drinking water. Algal blooms are now observable at the new water intake, and portend a renewal of taste and odor problems in the near future. Algal growth is conditioned by the high levels of inorganic nitrogen compounds and soluble phosphates discharged to the Lake from the Detroit and Raisin Rivers.

High ammonia concentrations at the Monroe water intake interfere with disinfection, and require the addition of excessive amounts of chlorine so that bacteria do not survive in drinking water.

Chloride concentrations at the Monroe water intake have increased from an average of 30 mg/l to 40 mg/l in the past four years. These chlorides originate primarily in the calcium chloride and lime wastes discharged from soda ash plants on the Detroit River. These wastes have increased hardness in the Monroe water supply by 25%, necessitating increased use of detergents for household cleaning.

Industrial Water Supply

Pollution of the Raisin River has become so complete that its lower few miles are offensive to sight and smell, and undesirable as a source of industrial water supply. Rising chloride levels indicate potential problems with corrosion of industrial equipment.

Recreation

Damages to recreational opportunities in Lake Erie and its Michigan tributaries may be the worst effects of pollution, inestimable in dollar figures. At beaches near the mouth of the Detroit River, any kind of water contact sports--even water skiing or boating--is hazardous. The beaches at Sterling State Park, in heavy demand by a metropolitan population of nearly four million (projected to reach 5 1/2 million by 1980), have had to be closed due to bacteriological contamination. The land area near the beaches is often offensive due to the washing ashore and depositing of sewage and industrial debris, often in an advanced state of decomposition. Even far away from shore spills of oil from boats, floating slicks of pollution, and turbidity due to heavy concentrations of microscopic life have destroyed the beauty of the Lake.

Fish and Wildlife Propagation

Deposits of sewage and industrial sludge on the bottom of Lake Erie and its tributaries in Michigan threaten to destroy the food and habitat that make life possible for any but tough, inedible species of fish. Large areas of the bottom of Michigan Lake Erie are already inhabited only by pollution tolerant organisms such as leeches and sludgeworms. Acute fish kills have been caused by discharges of oil and other toxic industrial wastes. In 1960 a heavy discharge of untreated waste slaughtered 10,000-12,000 ducks, or 50% of the wildfowl population of the area.

Heavy algal blooms and the spread of slime bacteria over large areas of the Lake in Michigan represent still another danger to aquatic life. These growths and the nutrients

which feed them consume large quantities of the dissolved oxygen, without which fish can neither propagate nor live. They also add to the turbidity of the water, depriving fish of needed light.

Navigation

Sludge deposits at the mouth of the Raisin, Detroit, and other Rivers tributary to the Lake require expensive annual dredging by the U.S. Army Corps of Engineers in order to preserve routine navigability.

Eutrophication of the Lake

The natural aging of a stagnant body of water (such as Lake Erie), its gradual enrichment with many varieties of plant and animal life and their deposits, is being accelerated by the discharges of nutrients and organic wastes into Lake Erie. If these discharges are not halted, turbidity in the Lake may increase until it becomes unusable for most purposes.

SECTION VII

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